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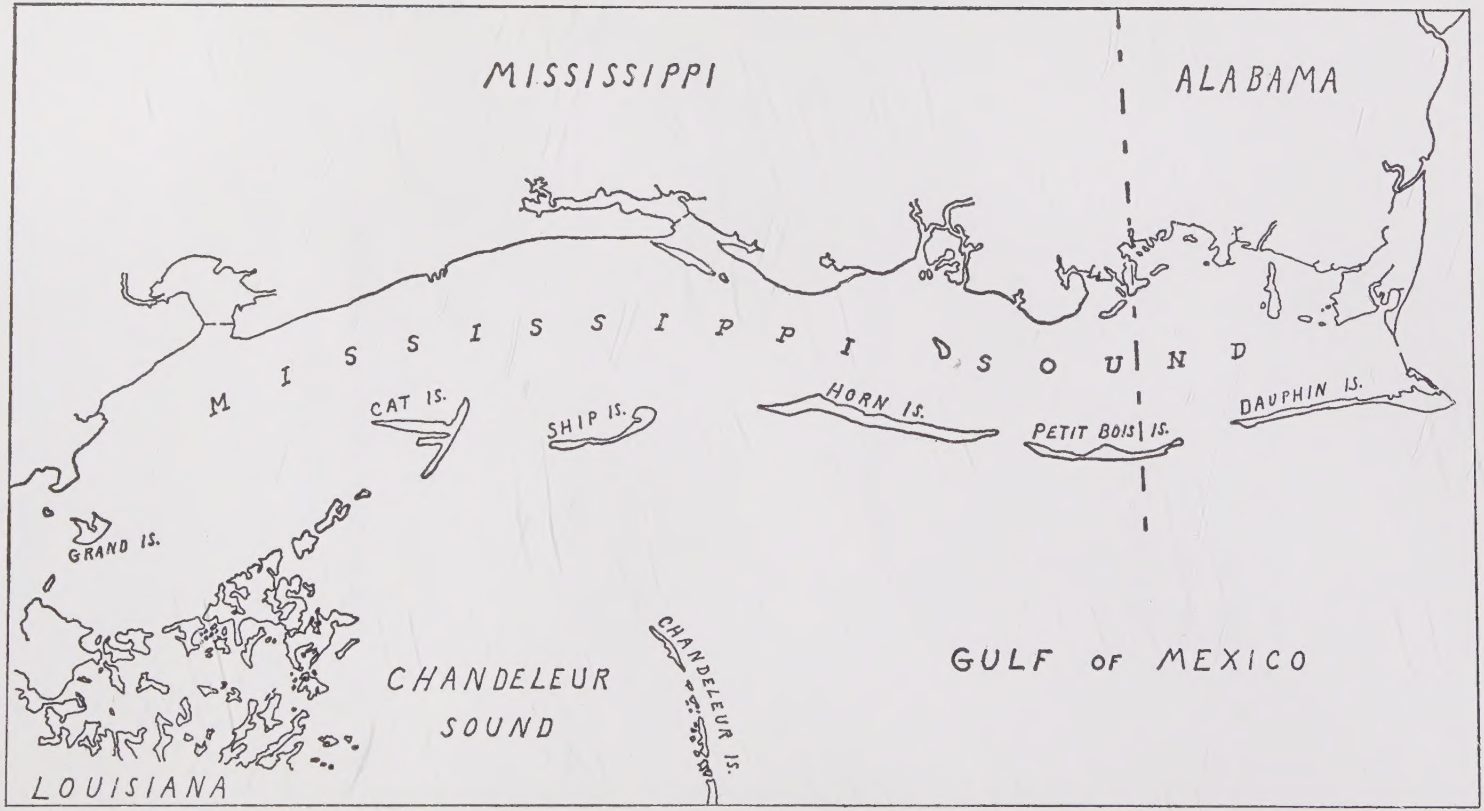


MAP OF THE MISSISSIPPI COAST

# THE MARINE AND BRACKISH WATER MOLLUSCA

of the

# STATE OF MISSISSIPPI

*by*

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## INTRODUCTION

The study of marine life of the Gulf of Mexico has progressed slowly as compared to other regions of the United States. Much of this lack of progress is probably due to the absence of universities in the coastal area, and the absence of large populated centers where marine research would be encouraged. The early work was done by travelers and expeditions from places remote to the Gulf. Only in the present century has there been any attempt to establish marine laboratories on this seaside. Most of these laboratories have been located in rather remote, inaccessible places, and have usually suffered from inattention by the parent institution. In recent years, however, the search for oil, industrial growth of coastal cities, and the development of beach resorts have brought new roads and more people to the coast. During the same time the Gulf fishing industry expanded enormously, and, in value, became the largest fishery of the several important fishing regions of the United States. For instance, according to Fisheries Industries of the United States for 1956, the Gulf coast produced more in pounds and value than the Pacific coast, and more in value than the New England states. This new growth has stimulated a demand for more scientific knowledge of the Gulf and its waters.

The scientific study of the Mollusca of the Gulf of Mexico has been carried on in the past in museums far from this region. The bulk of this work has dealt mainly with taxonomy, and even the geographical distribution of most species is poorly known. The writer's purpose in the present work is to give a brief history of prior work on Mollusca along the Mississippi coast, to identify the species found in the area studied, and to discuss what is known of the distribution, abundance, and habits of many of the species. The work was done at the Gulf Coast Research Laboratory in Ocean Springs, Mississippi, and was carried on concurrently while the writer was engaged in other duties and activities. Most of the specimens were collected near the Laboratory or around Horn and Ship Islands, but both ends of Mississippi Sound received attention, and it is believed that the collections are representative of the entire area. The writer did not attempt to work in fresh water, and limited the marine collections to the area inside a line drawn one mile south of the barrier islands.

The writer would like to thank those who have given freely of advice and help. In particular, he would like to thank Dr. Gordon Gunter of the Gulf Coast Research Laboratory, Drs. J. F. Walker and R. A. Woodmansee, Mississippi Southern College, Dr. Hugh Bernard, Shell Development Company and Dr. R. R. Priddy of Millsaps College.

## HISTORICAL ACCOUNT

Some shallow water mollusks of the northern Gulf of Mexico were first described by European zoologists in the latter half of the eighteenth and early part of the nineteenth centuries. Two Europeans, LeSueur and Rafinesque, came to this country in the early 1800's, and published some of their findings in American journals. Thomas Say was the first American to describe material from the Southern states. He made a collecting trip to Georgia and Florida in 1818, and

described a number of species which are common on the Mississippi coast. He was followed by T. A. Conrad who visited Alabama in 1833. Conrad was mainly interested in fossils, but some of those he described are found living in our coastal waters at the present time. The first publication specifically mentioning Mississippi marine mollusks is Wailes (1854), who listed one species of squid under Crustacea.

Many people began to collect and write about Gulf mollusks after the Civil War. Most of this activity, however, was centered on the west coast of Florida, and the central Gulf states were almost completely neglected. The first faunal list of species from the Mississippi coast was a very short one published by Stearns (1894). The next list of Mississippi mollusks was published by Vanatta (1904) on a collection from Horn Island. He listed thirty-five species, but did not indicate exactly where or how they were collected. Cary (1906) enumerated seventy-three species from the coast of Louisiana. This list is mentioned here because many of the specimens came from the same molluscan fauna as that found on the Mississippi barrier islands.

Nothing more was published on Mississippi mollusks, except oyster reef survey work by H. F. Moore (1913), until a series of short papers was published by various authors from 1952 onwards. Rosso (1952) listed six species of pelecypods found in Mississippi Sound, but which did not occur around Grand Isle, Louisiana. Ward *et al.* (1953) published a list of thirteen names, and Tolbert and Walker (1953), in a brief note discussed the general biology and distribution of Mississippi Mollusca. A paper by Walker (1953) listed the marine invertebrates, including mollusks, that had been collected by students and workers at the Gulf Coast Research Laboratory. He listed forty-seven species, but four names have been since dropped by the writer for the following reasons. One species was placed in three different genera, but all three names referred to the same animal. Another species was divided into two subspecies that are not believed to be valid. Another species is not found in the Gulf of Mexico, and was apparently based on a misidentified specimen. The most recent publication, D. R. Moore (1957), discussed the occurrence and distribution of the minute pelecypod, *Cuna dalli.*

In addition to the published reports, a checklist of the marine invertebrates was mimeographed by the Gulf Coast Research Laboratory in the summer of 1955. It contained a list of seventy mollusks, but eight of these were duplications or misidentified, or came from deep water some distance offshore and outside of the region treated in this paper.

## PROCEDURE OF WORK

The specimens studied by the writer were collected by every means possible. Many specimens were picked out of beach drift, and samples of beach sand were examined under the low power microscope. Many animals were captured in trawls or taken in bottom samples during work on board the Laboratory vessel, "Hermes." Other collections were made by skin diving, and by screening sand in shallow water near shore. The writer is indebted to several people who brought in material from collecting trips. W. J. Demoran and J. Y. Christmas of the Laboratory staff brought in a great deal of valuable material collected during the course of their field work,

and among the summer teaching staff, Dr. R. A. Woodmansee and Dr. H. J. Bennett were particularly helpful.

Activities of the living animals were observed in some cases, but, for many species, only empty shells were collected. The most important part of the work was the taxonomy of the local animals, and the identity of some species is still in doubt. As might be expected, it was the small species that proved to be difficult, and a great deal of literature was consulted in order to make determinations. The major reference works utilized include de Blainville (1825), H. and A. Adams (1858), Fischer (1880-87), Tryon (1881), Thiele (1928-35), Morton (1958), Abbott (1954), Smith (1937), Perry and Schwengel (1955), "Johnsonia" (1941 to 1959), Johnson (1934), Clench and Turner (1950), Dall 1890-1903), Olsson, Harbison, Fargo and Pilsbry (1953). A host of shorter papers and monographs were also consulted.

Specific determinations were based almost entirely on the shell alone, since very few marine mollusks have had their soft anatomy described, although the general classification of mollusks is based almost entirely on the soft anatomy of the animals.

## DESCRIPTION OF THE MISSISSIPPI COAST

The Gulf coast of Mississippi occupies a short stretch of coast line east of the delta of the Mississippi River. It is entirely a mud and sand environment except for pilings and a few rocks brought in by man. The major physiographic feature is Mississippi Sound, an elongate body of water partially enclosed by a series of barrier islands. The Sound is approximately eighty miles long by ten miles wide, and averages about ten feet in depth. The axis of the Sound is almost due east and west. The eastern end is at Grant's Pass near the lower end of Mobile Bay and the western end terminates at Grand Island, Louisiana, at the east end of Lake Borgne. Most of the bottom is mud, but this is replaced by sand close to the barrier islands and in some places along the mainland. However, several oyster reefs provide a firm substratum in the mud region. The eastern one-fifth of Mississippi Sound lies in Alabama.

The barrier islands lie along the southern flank of Mississippi Sound. They are long and narrow, and are oriented generally east and west. Although subject to a certain amount of shifting, the main part of the islands have been in existence for a considerable period of time, and all of them have considerable areas forested with Caribbean pine. From east to west, the first barrier is Dauphin Island, Alabama. It is approximately twelve miles long, but is very narrow except for three miles at the east end where the width is about a mile. This end forms the west side of the mouth of Mobile Bay. A causeway has been built from the mainland to the island, and it is now readily accessible to the public. Four miles to the west of Dauphin lies Petit Bois, a smaller island about six miles in length. The Alabama-Mississippi boundary cuts the island, with the larger portion lying in Mississippi. From Petit Bois to Horn Island is less than two miles. The channel between the two islands is known as Horn Island Pass and serves the port of Pascagoula. Horn Island is twelve miles long, and averages about a half mile in width. About half of the island is forested. The next in the series, Ship

Island, lies nearly five miles to the west of Horn Island. Much of the interval is made up of shallow banks, but Dog Keys Pass, just west of Horn Island, is a natural deep water pass, used mostly by shrimpers and menhaden boats. Ship Island is actually two islands connected by a narrow sand spit. The eastern portion is roughly triangular, and much of it is wooded. The western portion is elongate, low and flat, and without any wooded sections.

Cat Island lies four miles to the west of Ship Island. The body of water between these islands is Ship Island Pass, and a deep water ship channel is maintained through the pass and up the Sound to the city of Gulfport on the mainland. Cat Island differs from the other islands in that it is T shaped, although apparently, it was originally aligned with the other islands in an east-west direction. It appears that as the Mississippi Delta built out to the eastward, the Chandeleur Island arc was formed. The only direction that waves from the open Gulf can come on to Cat Island at the present time is from the ESE. The eastern part of the island now runs NNE by SSW and is long and narrow. This part of the island is thus at right angles to the direction of the waves, and was obviously formed by their action. Cat Island is the last of the barrier islands, for the remaining islands at the southwest end of the Sound are part of the Mississippi Delta system. The water around these islands is very shallow, but Cat Island Channel, between Cat Island and the delta islands, is more than forty feet deep in some places.

It can be seen that the writer is of the opinion that the Mississippi barrier islands were formed before the Chandeleur Islands. Dr. Hugh Bernard, of the Shell Development Company, has informed the writer (personal communication) that radiocarbon dating of shells gives an age of five to six thousand years for the Mississippi islands, and approximately half that age for the Chandeleurs.

The deep passes between the barrier islands are located close to the western tip of each island. Since waves from the open Gulf cannot come from the southwest because of the Mississippi Delta, all waves must come from the southeast quadrant. Each wave, when coming oblique to the beach, tends to move sand down the beach in the direction the wave is traveling. Each island has extended sand spits to the westward, and has displaced the tidal flow at the same time. The increased flow of water around the end of the spit has dug out fairly deep channels very close to shore, with depth ranges from about twenty to fifty feet. There is often an off-shore bar, however, where the depth is reduced to ten or twelve feet.

A number of smaller islands are found in Mississippi Sound close to the mainland shore. An exception is Round Island which is midway in the Sound between the mouth of the Pascagoula River and Horn Island. The two largest islands near the mainland are Isle Aux Herbes just south of Coden, Alabama and Deer Island which lies across the mouth of Biloxi Bay. Round and Deer islands are high, sandy and extensively wooded with pine; the remaining islands are low and marshy.

The shore of the mainland is often quite irregular, and indicates some degree of submergence. It is low, marshy and irregular along the east Mississippi and west Alabama coast, but much of the interval between Pascagoula and Waveland is a high sandy ridge. From Waveland westward to the Louisiana boundary it is once again low

and marshy. Biloxi Bay is long and narrow, and the inner seven and one-half miles is oriented east and west. The remaining three and one-half miles, east of U. S. 90 Highway bridge, runs in a NW-SE direction. Deer Island lies across the mouth of the bay, leaving a narrow channel along the eastern section of the city of Biloxi, and a wider channel between the east end of the island and Marsh Point on the mainland. The outer bay is shallow, much of it being less than six feet deep at low tide. The narrow channel in the inner bay, however, may be as much as thirty feet deep. Three small streams empty into the inner bay. They are: Old Fort Bayou, Biloxi River, and Bernard Bayou. Davis Bayou empties into outer Biloxi Bay opposite Deer Island, and it is here that the Gulf Coast Research Laboratory is located.

Bay St. Louis is only fifteen miles or so to the west of Biloxi Bay. Its shape, however, is much different. From the mouth to the northern shore is about six and one-half miles. The shape as seen on a chart is roughly that of a mushroom, with the top somewhat displaced to the westward. Two rivers, the Jourdan and the Wolf, empty into the bay on the west and east sides, respectively. The bay is quite shallow except at the mouths of the rivers where depths of ten to twenty feet are reported.

In addition to the streams flowing into the two bays mentioned above, a number of small streams flow directly into the Sound. The two most important rivers on the Mississippi coast are the Pearl and the Pascagoula. The latter empties into the Sound near the Alabama-Mississippi border. The Pearl flows into Lake Borgne about four miles west of Grand Island Pass, which in turn flows into the west end of Mississippi Sound. In 1902 the United States Supreme Court set the offshore boundary between the states of Louisiana and Mississippi as the channel, determined by depth, from the mouth of the Pearl River to the Gulf of Mexico.

The climate of lower Mississippi is moist and humid, and the salinity of the Sound is kept lower than the open Gulf by the inflow of fresh water from streams.

## THE PHYSICAL ENVIRONMENT

Many factors influence the variety and numbers of marine animals. The substratum, depth of water, waves and currents, salinity, temperature, and turbidity, all have a vital influence on the marine fauna.

Students of coastal animal communities usually rely heavily on salinity as the chief limiting factor. Thus Gunter (1945, 1950) related the presence or absence of animals largely to salinity. His studies, however, were based mainly on motile organisms. Most Mollusca are not capable of rapid movement, and might be excluded from an area by the grain particle size of the substratum or by the absence of plants where turbidity is unusually high. While not the only limiting factor, salinity is probably second only to temperature as a physical condition in most areas.

The terms, marine and brackish water, are somtimes used here to define general salinity conditions. The writer considers in this work that marine waters have a salinity of more than 25 parts per thousand, and that brackish waters have a lower salinity.

The salinity of the Mississippi coast varies with the amount of fresh-water runoff in the southern half of the state. There appears to be a seasonal variation with the highest salinities in the late fall and lowest in the summer, but this varies from year to year. A series of salinity readings taken during the years 1956-57 are given in Table I. The figures are in parts per thousand and were computed from specific gravities measured on a chain gravitometer. There are some anomalies in the salinity table, for more dense waters were sometimes found at the surface. In no case, however, is the difference in density very great, and may have been caused by both turbulence and by human error. It should be noted that in shallow Gulf coastal waters surface salinities higher than bottom salinities are fairly common (Cf. Gunter, 1945, Collier and Hedgpeth, 1950). The stations are described in the following paragraphs and their location is given in Figure I.

*TABLE I.* Surface and bottom salinities at Gulf Coast Research Laboratory Stations. Station I is between Marsh Point and Deer Island in the Bay of Biloxi. Station II is at the mouth of the Bay of Biloxi. Station III is half way across Mississippi Sound from Station II to Dog Keys Pass. Station IV is in the outside part of Dog Keys Pass. These salinities were computed from specific gravities measured on a chain gravitometer, and are given here in parts per thousand.

| Date | I | II | III | IV |
|---|---|---|---|---|
| 12/15/56 | | | | |
| Surface | | 28.44 | 25.33 | 33.32 |
| Bottom | | 27.72 | 28.68 | 33.32 |
| 2/9/57 | | | | |
| Surface | 11.91 | 9.58 | 19.21 | 26.53 |
| Bottom | 11.85 | 11.23 | 19.94 | 25.72 |
| 3/23/57 | | | | |
| Surface | 19.25 | 21.91 | 25.88 | 28.51 |
| Bottom | 19.25 | 23.88 | 26.54 | 27.20 |
| 4/6/57 | | | | |
| Surface | 6.56 | 9.17 | 8.66 | 27.36 |
| Bottom | 9.17 | 15.99 | 27.41 | 29.99 |
| 4/22/57 | | | | |
| Surface | 5.64 | 10.39 | 12.88 | |
| Bottom | 4.07 | 6.65 | 16.68 | |
| 6/15/57 | | | | |
| Surface | 17.42 | 20.16 | 23.08 | 27.68 |
| Bottom | 17.42 | 21.66 | 25.68 | 27.75 |

Station I was located between the tip of Marsh Point and Deer Island, II at the mouth of Biloxi Bay, III halfway between Station II and Dog Keys Pass, and Station IV was in Dog Keys Pass.

It can be seen in the above table that there is a gradient from low salinity in the mainland bay to high salinity in the barrier island pass. The salinity at Station IV, however, was still somewhat lower than oceanic water, which is generally about 36.5 parts per thousand in the Gulf of Mexico. Many marine animals can live where the salinity ranges down to about 25 parts per thousand, but the number of species falls off rapidly at lower salinities. The Mollusca are no exception to the general rule, and most of the species were found only around the barrier islands. A few species are conditioned to low salinities; they are invariably confined to the inner

MAP SHOWING THE FOUR GULF COAST RESEARCH LABORATORY STATIONS

bay or outer bayou region, or possibly brackish water ponds on the barrier islands.

Very wet or very dry periods can, of course, displace the salinity gradient seawards or landwards. The summers of 1958 and 1959 had unusually heavy precipitation, and salinities dropped to less than 1.0 at the Gulf Coast Research Laboratory. In the Sound, on the north side of Ship Island, surface salinities as low as 11.5 were encountered. Many animals that are capable of moving about undoubtedly descend to deeper, more saline water at such times, but sessile forms, and some others, sometimes suspend all activity until the fresh water is dispersed.

The temperature of Mississippi coastal waters fluctuates over a fairly wide range with the greatest variation occurring in the bays and bayous during the winter months. Summer temperatures do not usually show much variation between stations, for cool fresh water runoff helps to keep temperatures down close to the mainland. A series of temperature readings taken at the four stations already mentioned in Table I are given in Table II.

*TABLE II.* Surface and bottom temperatures in degrees Centigrade at the Gulf Coast Research Laboratory Stations described in the legend of Table I.

| Date | I | II | III | IV |
|---|---|---|---|---|
| 12/15/56 | | | | |
| Surface | | 18.3 | 18.4 | 19.0 |
| Bottom | | 18.3 | 17.0 | 19.0 |
| 1/26/57 | | | | |
| Surface | 14.4 | 14.4 | 14.8 | |
| Bottom | 14.3 | 14.0 | 14.8 | |
| 2/9/57 | | | | |
| Surface | 24.5 | 21.6 | 18.0 | 21.1 |
| Bottom | 24.0 | 21.9 | 17.0 | 16.0 |
| 3/9/57 | | | | |
| Surface | 12.4 | 12.5 | 14.1 | 18.0 |
| Bottom | 11.9 | 12.7 | 14.3 | 17.4 |
| 6/15/57 | | | | |
| Surface | 29.4 | 30.1 | 30.4 | 30.4 |
| Bottom | 29.5 | 29.6 | 30.15 | 29.7 |

The temperatures for February 9, 1957 were taken near the end of a period of unusually warm weather and are not typical of the usual Mississippi winter. The winter temperatures in Table II are probably higher than average, for during a cold wave the surface temperatures drop to 4.0° centigrade. Surface temperatures taken at Ship Island Lighthouse, Bumpus (1957), during the years 1930-32 had a mean of approximately 11° for the month of January. As these temperatures were taken at 8 a. m. and 6 p. m., they would reflect the daily average better than the temperatures in Table II which were taken between the hours of 9 a. m. and 3 p. m.

The remaining physical conditions, except the substratum, have not been studied in the Mississippi area. Turbidity is high and for long periods at a time Secchi disk measurements are less than one meter. This, of course, discourages ~~macrospic~~ macroscopic plant life, and nearly all of the attached algae and "grass" is found in shallow water on the north side of the barrier islands. Currents are mainly tidal or wind driven, so are usually of rather short duration. Waves are

apparently of little consequence except during high winds. The bottom slopes very gradually from the barrier islands southward, and acts as a dampener for large waves.

The substratum of Mississippi coastal waters has been investigated more thoroughly than the waters above it (Priddy *et al.* 1955). The bottom consists of mud or sand, and oyster reefs provide some natural hard bottom. Man has provided hard bottom in the form of pilings for docks and piers, rock jetties, and rocks in shallow water around Fort Massachusetts and the old quarantine station on Ship Island. Most of the man-made hard substratum is along the mainland where few species of mollusks are able to utilize it. The rocks at Ship Island, however, provide a habitat for a number of species that would not otherwise be found here. Another type of hard bottom consists of broken shell in the passes. Trawling in Dog Keys Pass usually produced a number of worn valves of *Dinocardium robustum,* and assorted worm tubes; bryozoans and small mollusks were usually found on these shells. Priddy (*op. cit.*) disregarded the infinitesimal hard bottom and gave the following estimates for the type of substratum in Mississippi Sound: sand 5 per cent, clay-mud 80 per cent, and silt or sandy silt 15 per cent.

The type of substratum has a great deal of influence on the molluscan population, for many species that are at home in sand cannot exist in mud. The oyster is a notable exception, but it needs some hard structure to fasten onto when the time comes for the young to settle on the bottom. Most pelecypods found living along the mainland shore are living in muddy sand, or, especially among the Pholadidae, in sandy mud or firm silt.

Most of the bottom of Mississippi Sound appears to be mud, and the surface layer is fine unconsolidated material which is easily stirred up by waves. Most mollusks are unable to keep fine material from clogging their gills; hence they are excluded from most of the area under discussion. On the other hand, the sand found on the barrier islands is often coarse, and probably permits some species to live there that are not to be found west of the Mississippi River, where the sand is much finer. One such species is the minute pelecypod *Cuna dalli,* which is smaller than some of the sand grains associated with it.

In general the conditions of the Mississippi coast are quite similar to those found on the Georgia and Carolina coasts. Much of the invertebrate populations are identical, and it is obvious that the two areas were not separated by the peninsula of Florida until relatively recent times. For this reason, the coast from south Texas to Cape Hatteras, North Carolina (excepting south Florida) is considered to be a single biogeographic area, the Carolinian Province. The climate is warm temperate, and the tropical element is scanty. Only those forms that are able to withstand rather wide extremes of temperature during the year can survive on the Mississippi coast.

## LIST OF MISSISSIPPI MARINE AND BRACKISH WATER MOLLUSCA

The following classification is essentially the same as that employed by Morton (1958), which differs slightly from that of Thiele

(1928-35), mainly in the addition of the class Monoplacophora, and in the subdivision of the Opisthobranchia and the Pelecypoda. He also adds a fourth order to the Cephalopoda, the deep sea Vampyromorpha. The large family Pyramidellidae has also been removed from the Prosobranchia, and placed under the order Cephalaspidea in the class Opisthobranchia on the basis of a number of anatomical resemblances. Two of the six classes of living mollusks, Monoplacophora and Amphineura, are not found on the Mississippi coast. The two existing species of Monoplacophora were described in 1957 and 1959 from deep water in the eastern Pacific, and this class is not likely to be found in the shallow waters of the northern Gulf of Mexico. The Amphineura, however, are well represented in the Gulf, but seem to be excluded from Mississippi coastal waters, possibly by low salinities.

Class Gastropoda
Subclass Prosobranchia
Order Archaeogastropoda
Family Fissurellidae
*Diodora cayenensis* Lamarck 1822
*Lucapinella limatula* Reeve 1850
Family Neritidae
*Neritina reclivata* Say 1822

Order Mesogastropoda
Family Littorinidae
*Littorina irrorata* Say 1822
Family Rissoinidae
*Rissoina chesneli* Michaud 1832
Family Vitrinellidae
*Cyclostremiscus trilix* Bush 1883
*Episcynia multicarinata* Dall 1889
*Solariorbis blakei* Rehder 1944
*Solariorbis mooreana* Vanatta 1904
*Teinostoma biscaynense* Pilsbry & McGinty 1945
Family Caecidae
*Caecum cooperi* Smith 1860
*Caecum* cf. *glabrum* Montagu 1803
*Caecum pulchellum* Stimpson 1851
*Meioceras nitidum* Stimpson 1851
Family Cerithidae
*Alabina cerithidioides* Dall 1889
*Bittium varium* Pfeiffer 1840
*Seila adamsi* Lea 1845
Family Cerithiopsidae
*Cerithiopsis greeni* C. B. Adams 1839
Family Triphoridae
*Triphora nigrocincta* C. B. Adams 1839
Family Epitonidae
*Epitonium rupicolum* Kurtz 1860
*Epitonium angulatum* Say 1831
Family Eulimidae
*Melanella intermedia* Cantraine 1835

Family Calyptraeidae
*Crepidula convexa* Say 1822
*Crepidula fornicata* Linne 1767
*Crepidula maculosa* Conrad 1845
*Crepidula plana* Say 1822
Family Strombidae
*Strombus alatus* Gmelin 1790
Family Naticidae
*Natica pusilla* Say 1822
*Polinices duplicatus* Say 1822
*Sinum perspectivum* Say 1831
Family Cassididae
*Phalium granulatum* Born 1780

Order Neogastropoda
Family Muricidae
*Murex fulvescens* Sowerby 1834
*Thais haemastoma* Linné 1767
Family Columbellidae
*Anachis avara* Say 1822
*Anachis obesa* C. B. Adams 1845
*Mitrella lunata* Say 1826
Family Buccinidae
*Cantharus cancellarus* Conrad 1846
Family Melongenidae
*Busycon perversum* Linné 1758
*Busycon spiratum* Lamarck 1816
Family Nassariidae
*Nassarius acutus* Say 1822
*Nassarius vibex* Say 1822
Family Fasciolariidae
*Fasciolaria hunteria* Perry 1811
Family Olividae
*Oliva sayana* Ravenel 1834
*Olivella* sp.
*Olivella mutica* Say 1822
*Olivella pusilla* Marrat 1871
Family Volutidae
*Scaphella junonia* Shaw 1808
Family Cancellariidae
*Cancellaria reticulata* Linné 1767
Family Terebridae
*Terebra concava* Say 1827
*Terebra dislocata* Say 1822
*Terebra salleana* Deshayes 1859
Family Turridae
*Kurtziella cerinella* Dall 1889
*Rubellatoma diomedea* Bartsch and Rehder 1939
*Nannodiella melanitica* Bush 1885

Subclass Opisthobranchia
Order Cephalaspidea
Family Acteonidae
*Acteon punctostriatus* C. B. Adams 1840

Family Atyidae
*Haminoea antillarum* d'Orbigny 1841
*Haminoea succinea* Conrad 1846
Family Retusidae
*Retusa canaliculata* Say 1822
Family Acteocinidae
*Cylichna bidentata* d'Orbigny 1841
Family Gastropteridae
*Gastropteron rubrum* Rafinesque 1814
Family Pyramidellidae
*Odostomia impressa* Say 1822
*Odostomia seminuda* C. B. Adams 1839
*Odostomia* sp.
*Turbonilla conradi* Bush 1899
*Turbonilla* sp.

Order Anaspidea
Family Aplysidae
*Aplysia willcoxi* Heilprin 1886

Order Thecosomata
Family Cavolinidae
*Cavolina longirostris* LeSueur 1821
*Cresis acicula* Rang 1828

Order Nudibranchia
Family Polyceridae
*Polycera hummi* Abbott 1952
Family Corambidae
*Corambella baratarioe* Harry 1953
Family Arminidae
*Armina tigrina* Rafinesque 1814
Family Scyllaeidae
*Scyllaea pelagica* Linné 1758
Family Flabellinidae
*Eubranchus* sp.

Subclass Pulmonata
Order Basommatophora
Family Ellobiidae
*Melampus bidentatus* Say 1822

Class Scaphopoda
Family Dentaliidae
*Dentalium texasianum* Philippi 1848
*Dentalium eboreum* Conrad 1846

Class Pelecypoda
Order Protobranchia
Family Nuculanidae
*Nuculana acuta* Conrad 1831

Order Taxodonta

Family Arcidae

*Anadara brasiliana* Lamarck 1818
*Anadara ovalis* Bruguière 1792
*Anadara transversa* Say 1822
*Noetia ponderosa* Say 1822

Order Anisomyaria

Family Mytilidae

*Amygdalum papyria* Conrad 1846
*Brachidontes recurvus* Rafinescue 1820
*Lithophaga bisulcata* d'Orbigny 1846
*Modiolus demissus* Dillwyn 1817
*Musculus lateralis* Say 1822

Family Pinnidae

*Atrina seminuda* Lamarck 1819
*Atrina serrata* Sowerby 1825

Family Plicatulidae

*Plicatula gibbosa* Lamarck 1801

Family Pectinidae

*Aequipecten irradians* Lamarck 1819

Family Ostreidae

*Crassostrea virginica* Gmelin 1792
*Ostrea equestris* Say 1834

Order Heterodonta

Family Crassatellidae

*Crassinella lunulata* Conrad 1834
*Cuna dalli* Vanatta 1904

Family Carditidae

*Cardita floridana* Conrad 1838

Family Corbiculiidae

*Polymesoda caroliniana* Bosc 1801

Family Diplodontidae

*Diplodonta punctata* Say 1822

Family Lucinidae

*Lucina amiantus* Dall 1901
*Lucina floridana* Conrad 1833
*Lucina multilineata* Tuomey & Holmes 1857

Family Chamidae

*Chama congregata* Conrad 1833

Family Leptonidae

*Kellia suborbicularis* Montagu 1804
*Mysella cuneata* Verrill 1898
*Mysella planulata* Stimpson 1851

Family Cardiidae

*Dinocardium robustum* Solander 1786
*Laevicardium laevigatum* Linné 1758
*Laevicardium mortoni* Conrad 1830

Family Veneridae
*Callocardia texasiana* Dall 1892
*Chione cancellata* Linné 1767
*Chione grus* Holmes 1858
*Chione intapurpurea* Conrad 1849
*Dosinia discus* Reeve 1850
*Gemma gemma* Totten 1834
*Macrocalliata nimbosa* Solander 1786
*Mercenaria mercenaria* Linné 1758
*Parastarte triquetra* Conrad 1845
Family Petricolidae
*Petricola pholadiformis* Lamarck 1818
Family Tellinidae
*Macoma constricta* Bruguière 1792
*Macoma mitchelli* Dall 1895
*Strigilla mirabilis* Philippi 1841
*Tellidora cristata* Recluz 1843
*Tellina alternata* Say 1822
*Tellina iris* Say 1822
*Tellina texana* Dall 1900
*Tellina versicolor* DeKay 1843
Family Semelidae
*Abra aequalis* Say 1822
*Abra lioica* Dall 1881
*Cumingia tellinoides* Conrad 1831
*Semele nuculoides* Conrad 1841
*Semele proficua* Pultney 1767
Family Donacidae
*Donax variabilis* Say 1822
Family Sanguinolariidae
*Tagelus plebeius* Solander 1786
*Tagelus divisus* Spengler 1794

Order Adapedonta
Family Solenidae
*Enis minor* Dall 1900
Family Mactridae
*Labiosa plicatella* Lamarck 1818
*Mactra fragilis* Gmelin 1792
*Mulinia lateralis* Say 1822
*Rangia cuneata* Gray 1831
*Spisula solidissima* Dillwyn 1817
Family Mesodesmatidae
*Ervillia concentrica* Gould 1862
Family Corbulidae
*Corbula* sp.
Family Gastrochaenidae
*Rocellaria stimpsonii* Tryon 1861
Family Pholadidae
*Barnea truncata* Say 1822
*Cyrtopleura costata* Linné 1758
*Diplothyra smithii* Tryon 1862
Family Teredinidae
*Bankia gouldi* Bartsch 1908

Order Anomalodesmata
Family Lyonsiidae
*Lyonsia floridana* Conrad 1849
Family Pandoridae
*Pandora trilineata* Say 1822

Class Cephalopoda
Subclass Coleidea
Order Decapoda
Family Loliginidae
*Loligo pealei* LeSueur 1821
*Lolliguncula brevis* de Blainville 1823

Order Octopodidae
Family Octopodidae
*Octopus vulgaris* Lamarck 1798

## DISCUSSION OF THE SPECIES

Unfortunately, little can be said concerning many of the species beyond a simple statement as to where they occurred, and their probable abundance For some species, however, the writer has gathered additional information concerning habits and life histories. The same classification as that of the systematic list of species is followed, but some of the higher categories, such as Subclass are left out.

### FISSURELLIDAE

The shells of this family are secondarily bilaterally symmetrical. They are limpet shaped, and have either a slit or a hole in the shell. The animal is primitive, and retains a pair of gills in the mantle cavity.

*Diodora cayenensis.* This keyhole limpet was taken only in small numbers in Dog Keys Pass living on pieces of old shells and other debris. It will probably be found in any similar habitat along the coast. Maximum size about 35 to 40 mm.

*Lucapinella limatula.* This species is very similar to the preceding one. However, the shell is much more depressed, and the animal is not enclosed by the shell as in *Diodora cayenensis.* A further difference between the two is that the internal callus around the apical slit is truncate posteriorly in *D. cayenensis* and is rounded in *L. limatula.* The animal of the latter differs from the former in the possession of papillae at the apical slit, three before and four behind. One live specimen on broken shell from Dog Keys Pass. Maximum size about 20 mm.

### NERITIDAE

The columella in this family is shelf like, and is somewhat similar in some respects to that found in *Crepidula.* Unlike *Crepidula,* however, the animals are active browsers. This is the only family in the Archaeogastropoda that has penetrated fresh water.

*Neritina reclivata.* The river snail is usually found in shallow water in low salinity bayous and bays. It has been collected as far down Biloxi Bay as the U. S. 90 Highway bridge. It is also

abundant on the west side of Mobile Bay about two miles south of the mouth of the Fowl River. The eggs are laid in flat oval cases, half a dozen or so at a time. The shell is rounded, smooth, green in color, and with many narrow, wavy, black axial lines. Maximum size about 15 mm. This species was erroneously reported to live on vegetation above the surface of the water by Parker (1956).

## LITTORINIDAE

This is a family of rather simple appearing snails that has moved out of the sea, yet must stay close to salt water. The eggs are shed into the water, and there is a free swimming veliger.

*Littorina irrorata.* This is an extremely abundant species in the marshy areas along the mainland. It leaves the water after a pelagic larval existence, but must remain in a damp habitat at the water's edge. It is usually found living on the salt water marsh grass, *Spartina,* or on the rush, *Juncus,* but is sometimes found on bridge pilings or other man-made structures. It has been observed copulating in July and August.

The shell is dull tan in color, with sculpture of many spiral cords. The aperture is rounded and is closed entirely by the corneous operculum. Maximum size about 25 mm.

## RISSOINIDAE

In this family, the shells are elongate, white, and variously sculptured. They are most abundant in shallow warm seas.

*Rissoina chesneli.* This little snail has not been reported on the northern Gulf coast before. It is elongate, white in color, and has about a dozen axial ribs per whorl. Maximum size is about 4 mm.

Several specimens, one living, were taken in shallow water on the north side of Horn Island.

## VITRINELLIDAE

The vitrinellids are minute, white, depressed snails and are among the smallest gastropods known.

*Cyclostremiscus trilix.* Members of this family are minute, flat and disk like. The whorls are added on a more or less horizontal plane. This species has a minute projecting apex and the whorls are angled on the shoulder, base, and periphery. A few specimens have been found in beach drift on the barrier islands. Maximum diameter about 2 to 3 mm.

*Episcynia multicarinata.* This species is not as flat as the other members of the family in this region, and is more trochoid in shape. In addition, there is a finely toothed carina on the periphery of the whorls. Maximum diameter, 3 to 4 mm. One specimen in beach drift from Dauphin Island.

*Solariorbis blakei. Vitrinella blakei* Rehder, 1944, Nautilus 57 (3): 97, plate 9, figures 1, 2. This species is not in the genus *Vitrinella* as we understand it today. The chief difference between the two genera is the heavy ridge which constricts the umbilicus in *Solariorbis.* This structure is very strongly developed in *S. blakei,* and, in this feature, it greatly resembles the type of the genus, *Solariorbis depressus*

Lea. It also has axial wrinkles on the spire which are very similar to those found on *S. bartschi* Vanatta, a species which apparently does not range as far north as Mississippi. In some *S. blakei* the umbilical ridge is exceptionally well developed and the umbilicus is closed except for a minute oblique chink. These specimens appear at first glance to belong to the genus *Teinostoma,* but, in that genus, the umbilicus is entirely closed by a plug of shelly material and is formed differently from the umbilical ridge of *Solariorbis.*

Only two dead and broken specimens were taken in Ship Island Pass, but the small size (diameter, 1 mm.) of this species makes it easy to overlook.

*Solariorbis mooreana. Vitrinella mooreana* Vanatta, 1904, Proceedings of the Academy of Natural Sciences of Philadelphia 55 (1903): 756-759. Type locality, Crooked Island, St. Andrews Bay, Florida. This species also has a strong umbilical ridge, and unquestionably belongs in the genus *Solariorbis.* It is larger than the preceding species with a maximum diameter of nearly 3 mm. In addition, there are about five to seven spiral cords on the top half of the shell, the lower half being smooth. Several specimens have been found in beach drift on Dauphin, Horn and Ship Islands.

*S. mooreana* seems to be endemic to the northern Gulf Coast, but it appears to be known only from the five type specimens at the Academy of Natural Sciences in Philadelphia and the material the writer has collected. Nothing is known of the animal, but the operculum is thin and circular. It is multispiral, and is light tan in color.

*Teinostoma biscaynensis.* One somewhat immature specimen was taken in Dog Keys Pass. The umbilicus is completely filled by a callus, an important characteristic of the genus. Maximum size 1.8 mm.

## CAECIDAE

The shells of this family are simple curved tubes, closed at the posterior end by a shelly plug.

*Caecum cooperi.* This minute white species attains a length of about 4 mm. There are about 15 longitudinal ribs, and two or three heavy axial rings at the anterior end. The animal appears to be shy and retiring in strong light, and evidently prefers to live below the well lighted zone in rather turbid coastal waters. As is the case in the preceding two families, the small size of the individual makes it extremely difficult to estimate abundance, but it appears to be a fairly common species.

*Caecum cf. glabrum.* This species has a smooth, cylindrical, slightly curved shell with a dome like apical plug. It has been known in collections as *C. glabrum* for the past one hundred years or so, but it is apparently not that species. Specimens from Dog Keys Pass were sent to Dr. Harald Rehder, Curator of Mollusks, United States National Museum, who replied as follows. "I have examined these small caecids, and I thought at first that they were specimens of *Brochina glabra* Montagu. This species, however, is distinguished from most of the other species by having a conical operculum, whereas all the others are flattened and discoid. Your specimens have the operculum of typical *Caecum,* but with the shell characters of *Brochina.* Whether this means that your specimens belong to a new subgenus under *Caecum* or *Brochina,* I do not know; I will have to go into this

question a little more deeply and examine more specimens. I hope to be able to include the results of my findings in a paper I am writing on some new and interesting marine mollusks from the Caribbean and Gulf area."

This interesting species lives in much the same habitat as *C. cooperi,* and most of the writer's specimens came from trawling in Dog Keys Pass. Maximum size about 2 mm.

*Caecum pulchellum.* The sculpture consists of about two dozen axial rings. It is not common on the Mississippi coast. Maximum size about 2 mm.

*Meioceras nitidum.* This distinctive little species is very bulbous in the middle, and has an oblique, constricted aperture. Glassy, mottled by patches of chalk white. It was only collected once, crawling on algae trawled just north of Horn Island in a depth of about 20 feet. Maximum size 2 mm.

*Meioceras lermondi* Dall, 1924, was described from eleven specimens from Boca Ciega Bay, on the west coast of Florida. The characters appear to be the same as are found in the typical *M. nitidum,* and the name should be placed in synonomy with that species.

*M. nitidum* is not affected by strong light, and will crawl about actively and feed while being observed under the microscope. It does not eat macroscopic algae, but scrapes the surface with the radula, picking up minute diatoms and other small attached organisms. The tentacles are ciliated, and the eyes are small and black. Evidently the reduced salinity in Mississippi Sound is responsible for the species living in deeper water there, for the salinity is usually higher in the deeper parts of the Sound. At Miami, Florida, the writer has collected living specimens in only an inch or two of water. In this case, however, the salinity was very close to that of the open sea. It is a common species in the Gulf and Caribbean wherever there is abundant submarine vegetation.

## CERITHIDAE

Elongate spiral shells, usually with a short siphonal canal.

*Alabina cerithidioides.* A minute glassy species. Maximum size about 3 mm. It does not appear to be abundant, for only a few specimens have been found in beach drift on the barrier islands.

*Bittium varium.* This is a minute form which is probably the most abundant gastropod on the Mississippi coast. Its color ranges from light brown to black. Sculpture consists of four spiral cords crossed by axial riblets. A varix is usually formed on the body whorl a little behind the outer lip. To 4 or 5 mm.

The abundance of this little gastropod is not evident unless some sort of special collecting method is utilized. It lives in great numbers on marine "grass," and any method which knocks the animals off onto a cloth or screen will collect large numbers in a few minutes where they are abundant. The numerous eggs hatch out into free swimming veliger larvae that must often form a large proportion of the inshore planktonic animals.

It has been noticed that *B. varium* tends to live in somewhat deeper water in Mississippi Sound than in other localities the writer has examined, such as Aransas Bay, Texas. It may be that the lower salinities of surface waters in the Sound force this species to live in deeper water in Mississippi.

*Seila adamsi.* This is a very long and slender little gastropod. There may be as many as fifteen post-larval whorls in a shell 15 mm. long. The sculpture consists of three strong spiral cords on the whorls and two more on the base of the shell. The color is brown.

The species appears to be fairly common in the deeper part of Dog Keys Pass, for all of the specimens collected were picked out of shell debris brought up by the trawl.

## CERITHIOPSIDAE

This group is similar to the preceding family, but all of the species are small. The larval whorls are very slender, and the post larval shell expands rapidly. This gives the apex a somewhat mammillated appearance and is quite distinctive. The exterior of the shell has a beaded appearance.

*Cerithiopsis greeni.* This species looks superficially very much like *Bittium varium.* However, there is no varix, and the shell has a more beaded appearance. It attains a size of 4 or 5 mm.

The species listed up to this point are all herbivores as far as is known at present. *Cerithiopsis,* however, feeds on sponges and must be classed as a carnivore, although its feeding techniques are probably little changed from that of a typical herbivore. All of the specimens of *C. greeni* were collected from the north side of Ship Island. The under side of some rocks at both the old Quarantine Station and at Fort Massachusetts is covered by a sheet of encrusting yellow sponge which is, as yet, unidentified. *C. greeni* was fairly common on this sponge, but has not been found anywhere else.

## TRIFORIDAE

The triforids are very similar to the preceding family, but differ in being coiled to the left. They are all small shells and have similar habits to *Cerithiopsis.*

*Triphora nigrocincta.* A shell very similar to *Cerithiopsis greeni.* The sinistral coiling of *T. nigrocincta,* however, makes it extremely simple to tell them apart. The only other sinistrally coiling species in this region is very large and has a quite different appearance.

It has been collected on a gray encrusting sponge underneath rocks at both the old Quarantine Station and at Fort Massachusetts. Although found at the same localities, there was no mixing with *C. greeni.* The latter was confined to yellow sponge, and *T. nigrocincta* was found only on gray sponge. It was not as abundant as *C. greeni,* but was still fairly common.

In addition, two living specimens were collected in a trawl haul from a deep channel just north of Horn Island. Most of the catch was algae of various types, but there may have been sponges on the bottom that were not picked up by the trawl.

## EPITONIDAE

Elongate, usually white, and with numerous blade like axial ribs.

*Epitonium angulatum.* A white shell that attains a length of 20 mm. The ribs are angled near the posterior end.

Occasional specimens are found in shallow water around the barrier islands.

*Epitonium rupicolum.* Shell brown. Ribs are very low and fine except for an occasional heavy one. There is a thick varix on the outer lip, and a spiral rib on the base of the shell. One specimen, with hermit crab, was taken on the north side of Horn Island.

## CALYPTRAEIDAE

The shell is more or less limpet shaped and is open ventrally. The columella has been modified to form an internal shelf. The single gill is greatly enlarged and modified to serve as a food gathering organ as well as for respiration, and in this respect bears some resemblance to the pelecypods.

*Crepidula convexa.* A small highly arched form, dark brown inside and out. The shelf edge is almost straight. Seldom more than 15 mm. in length.

This species is fairly common on the "grass" flats on the north side of the barrier islands. It is often found living on the blades of turtle grass, and this appears to be its principal habitat, at least in this area.

*Crepidula fornicata.* This is a large white form with brownish blotches. The edge of the shelf is strongly sinuate. It reaches a length of about 60 mm.

This is the largest and best known American *Crepidula.* In some localities it is considered a pest, for large numbers together can compete with oysters for food. *C. fornicata* is not very numerous in Mississippi Sound, and it is not a pest in these waters.

*Crepidula maculosa.* This species is very similar to the preceding one, and grows almost as large. The edge of the shelf, however, is straight or nearly so. Like *C. fornicata,* it is not very common on the Mississippi coast, and only a few specimens have been found.

*Crepidula plana.* This snail differs from the other Crepidulas in being white in color, and having a low, flattened, or even concave outline. It is usually found inside old gastropod shells along with various species of hermit crabs. It is a common species from the middle of Mississippi Sound, the grass flats north of the barrier islands, in the passes, and offshore. Salinities along the mainland appear to be too low for it to occur there.

## STROMBIDAE

Rather large animals with heavy shells. The eyes are extremely well developed for gastropods, and the foot is poorly developed. The animal moves by thrusting the long narrow operculum into the ground, then pulling itself forward.

*Strombus alatus.* This snail has a fairly heavy shell with an extra notch in the outer lip near the siphonal canal. There is a single row of nodules on the shoulder just below the suture, and the spire is fairly well extended and pointed. It attains a length of around 100 mm.

Dead shells occupied by hermit crabs are fairly common around the barrier islands, but the writer has seen only one live specimen. This was collected by W. J. Demoran on a shallow grass flat near Fort Massachusetts, Ship Island, on October 14, 1956.

Young specimens resemble the Conidae (cone shells), and are often mistaken for members of that family. However, the absence of a creeping foot, and the well developed eyes are stromboid characters not found in the Conidae.

## NATICIDAE

The shell in this family is rounded, and has a very low spire. The genera *Natica* and *Polinices* differ mainly in the operculum which is calcareous in *Natica* and corneous in *Polinices*. The two Mississippi forms also differ greatly in size.

*Natica pusilla.* This is a small brown and white species with a slightly extended spire. Maximum size about 3 mm.

Sand bottom, shallow, high salinity water, and wave action or currents appear to be habitat requirements. These snails are carnivores, and feed on small clams living in the sand. A small hole is drilled by the radula through one valve close to the umbone. After the hole is drilled through, the proboscis is inserted and the radula rapidly rasps away the flesh of the clam.

The eggs are laid in a small simple circular sand ribbon, 7 or 8 mm. in diameter. The capsules in a specimen examined under the microscope each contained only a single veliger larva. The larvae were not observed after hatching, but are probably planktonic for some time before taking up a more sedentary existence on the bottom. Egg cases have been noted in June and July. It is found in small numbers just offshore on the Gulf side of the barrier islands, and in the passes between the islands. Collections of living material have been made so far at depths of about eight to twelve feet just off the Gulf side of Ship Island opposite Fort Massachusetts, and in about six feet on the shallow bar between Ship and Horn Islands. It has not been found on the north side of the barrier islands.

*Polinices duplicatus.* Very similar to *Natica pusilla* in shape, but there are no spots or blotches, and the size is much larger. Maximum size about 75 mm.

This is a much better known animal than the preceding species. Although usually buried to an inch or so beneath the surface of the sand, it leaves a large easily followed trail. There is usually a small mound at the end of the trail where the animal is feeding or resting. This species is responsible for a large proportion of bored clam shells found on the northern Gulf beaches.

The eggs are deposited in a sand ribbon which has a characteristic "collar" or constriction near the dorsal edge. There may be more than one egg in each capsule, and the young hatch out as veliger larvae. Very young post-larvae have glassy shells, and may be confused with the Vitrinellidae. The aperture, however, is rather elongate whereas in vitrinellids it is usually circular.

*P. duplicatus* is fairly common, for a carnivore, in the sand around both sides of the barrier islands. It is also found living in sandy areas along the mainland, and live specimens have been taken in one to three feet of water at Biloxi, the west end of Deer Island, and off Belle Fontaine Point. Although the species is rarely found in mud, one specimen was taken at the Laboratory Station III in Mississippi Sound.

*Sinum perspectivum.* The shell is white, very depressed, and with

a broadly open, oblique aperture. There is no operculum. Maximum size of the shell is about 35 mm., but the animal may be up to 100 mm. long. In both *Natica* and *Polinices* the animal is somewhat modified for locomotion beneath the surface of the sand. A head "shield" is developed by the anterior portion of the foot and the head for plowing through sand. When expanded, the body nearly surrounds the shell, and apparently in *Polinices,* this is accomplished partially by the intake of water into spaces within the foot. The animals in both genera are able to retire within the shell, and the aperture is entirely closed by the operculum. *Sinum* has evolved much further for a life beneath the surface. The shell is almost entirely internal, and the animal is much too large to withdraw within. The animal is white with no trace of color, and is considerably depressed and oval in outline when seen from above. Little is known concerning its habits.

This snail is rare on the Mississippi coast and only three specimens were collected during a four year period. One was taken at a depth of about fifteen feet off the south side of Ship Island. Another was taken in twelve feet of water about two miles from the west end off the north side of Horn Island. One specimen was found in a trawl haul two miles south of the east end of Deer Island, not far from the mainland shore.

## CASSIDIDAE

Rather large gastropods for the most part, whose chief distinguishing feature is the deposition of shelly deposits on the ventral surface (parietal wall) of the shell. In some species it forms a flat shield by this process in which the edges are more or less free from the main part of the shell.

*Phalium granulatum.* The shell has a short pointed spire, a long narrow aperture, spiral sculpture of numerous impressed lines, and a heavy varix or rib on the outer lip. In addition, there is a parietal shield, and five or six spiral rows of brownish spots. Maximum size about 90 mm.

This species appears to be strictly marine, and has not been found in Mississippi Sound. Moore (1956) reported that specimens he observed at Pensacola, Florida, were feeding on the sand dollar, *Mellita quinquiesperforata.* Except for this single observation, little is known concerning habits and life history of the species. Living specimens appear to be rare on the Mississippi coast, perhaps because of somewhat reduced salinities. Most shells seen by the writer were occupied by hermit crabs.

## MURICIDAE

The "rock shells" are usually spiny, and possess three or more varices on each whorl. Some genera, however, do not have varices, and may or may not have spines.

*Murex fulvescens.* An exceptionally spiny species. The spines are located on the varices, which number about six or seven to the whorl. Maximum size is close to 200 mm.

This species is a common offshore form, but is usually rare in shallow coastal waters. Three records for Mississippi are known.

One was collected on an old wreck a short distance north of Ship Island by W. J. Demoran, and two others were trawled in Dog Keys Pass. Occasionally dead shells occupied by hermit crabs are also found.

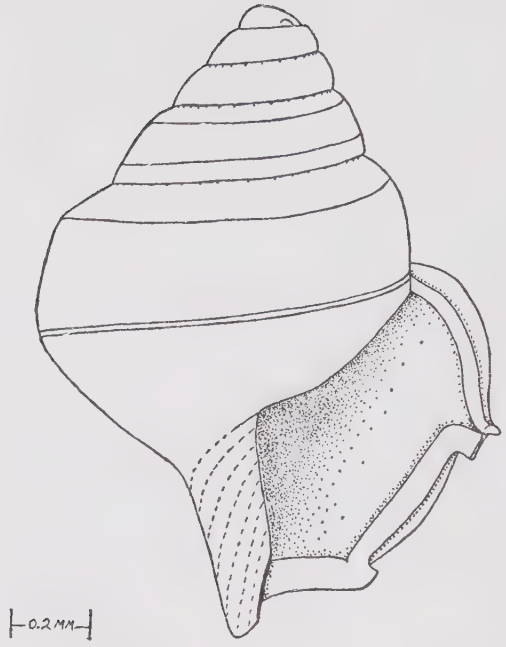
The egg capsules have not as yet been described or figured. These are usually attached to the shell of another *M. fulvescens,* for, since they live on muddy or sandy bottom, a hard substratum for the attachment of the capsules is rare. The capsules are tall and slender, and a little wider than thick. Measurements for one typical specimen are: height, 14 mm., width, 5 mm., thickness, 2.5 mm. The escape port is oval, and has a large diameter of about 0.6 mm. There is a thin flattened ridge around the distal end. The ridges do not meet on one side, but turn when about 2 mm. apart, and descend vertically. They gradually become smaller, and disappear about one-third the way down the capsule. There are also two smaller ridges on the sides of the capsule giving it something of a football shape in cross-section. There is no color to the capsule, but the eggs are purple. There are over a hundred eggs to the capsule, and they undoubtedly hatch out as a planktonic veliger. The capsules from which these observations are made were collected some distance off-shore during the first week of July 1957.

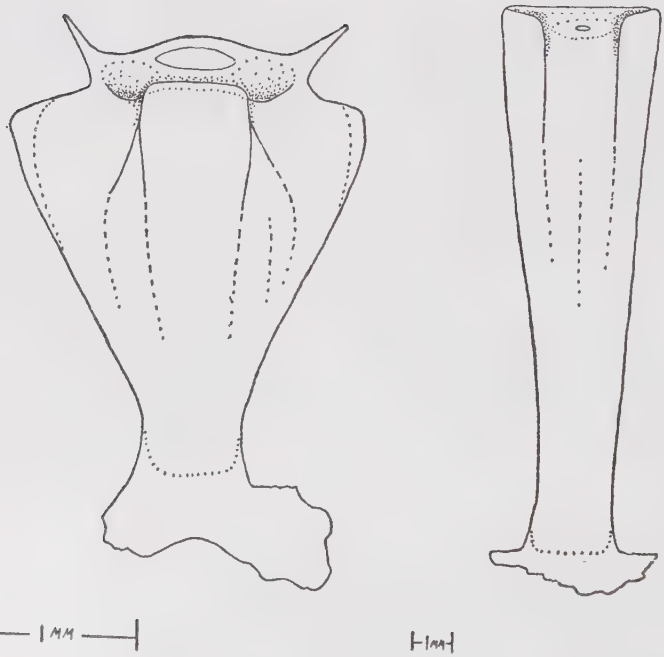
*Thais haemastoma.* The shell of the oyster drill is quite variable. The result is that many names have been applied during a span of nearly two centuries. According to Clench (1947), there are two subspecies in the northern Gulf, *T. h. floridana* and *T. h. haysae.* They are both found in the same region, however, and certainly do not fit into the recognized definition of subspecies. The two forms are apparently ecological variants found under somewhat different physical conditions. The form *haysae* is found in the Sound on oyster reefs and along the mainland on jetties, pilings, and other man made structures. The form *floridana* is found on rocks and pilings around the barrier islands.

The biology and habits of the oyster drill have been investigated by Burkenroad (1931) and others. They have found that the female lays many egg capsules, and that each capsule contains several hundred to more than a thousand eggs. The resulting veligers that hatch out are very small, and apparently remain in the plankton for some time, perhaps for as long as two months.

Young postlarval specimens have been figured and discussed by Craven (1883), Crosse (1885), and Dautzenberg (1889). Dautzenberg commented that the larval portion of his specimen was very similar to *Sinusigera colbeauiana* Craven. A monograph had been published by Craven (1877) on larval muricids under the mistaken impression that these were adult gastropods, so, naturally, no attempt was made to relate the larval form to the adult shell.

The larval shell is a typical sinusigera, originally named as a genus by d'Orbigny. Sinusigera larvae have part of the outer lip projected in a claw like extension some distance in advance of the remainder, and are typical of many Muricidae which have planktonic larvae. Full grown larvae have been found in the months of June, July, and August. The writer has collected them in shallow water close to the beach clinging to drifting pieces of grass. This appears to be the mechanism by which the young are carried inshore to the brackish water bays and sounds. The gentle breezes during the




Upper. Sinusigera larva of *Thais haemastoma.*

Lower left. Egg capsule of *Cantharus* ~~reticulata~~ canaliculus

Lower right. Egg capsule of *Murex fulvescens.*

summer months almost always blow toward the shore. Bits of seaweed and grass are gently pushed to shore, and, where there are passes, into brackish waters. Countless numbers undoubtedly perish on the open beaches, but enough reach favorable habitats to be regarded as serious pests wherever there are oysters.

**Description of the full grown larval shell.**

The shell is light brown, and measures 1.6 mm. by 1.1 mm. There are five whorls which are smooth except for extremely minute punctae on the body whorl. In addition, there are six or seven minute ridges on the siphonal canal, and two spiral cords on either side of the periphery. There are also exceedingly minute, numerous, very short axial riblets just below the suture.

The middle portion of the outer lip bears a slender, hooked projection. A smaller projection is close to the end of the siphonal canal. Larval growth terminates in a thin blade like varix which stands up above both the larval and post larval shell.

## COLUMBELLIDAE

These animals have small slender shells, and the family, like the preceding three, is carnivorous.

*Anachis avara.* This is a small slender shell with about a dozen low axial ribs. There are also weak spiral incised lines which are stronger on the siphonal canal. The narrow aperture is almost half the length of the shell. Maximum size about 14 mm.

Puffer and Emerson (1953) refer to *A. avara* as a herbivorous organism, and Keen (1958) states that columbellids may be seen plowing about on the floor of a tide pool . . . searching for the minute organisms on which they feed. Both of these statements are at variance with the writer's observations. At Miami, Florida, *Nitidella ocellata* Gmelin, another columbellid, was seen feeding on small *Isognomon* sp., a pelecypod attached to hard substratum with a byssus. There was no sign of a drilled hole, and, apparently, the proboscis was simply forced between the two valves of the pelecypod.

At Port Aransas, Texas, the writer fed snails to *A. avara.* As with *Nitidella,* there was no attempt to bore a hole. Instead, the proboscis was forced past the operculum, and the snails were rapidly consumed. Instead of being a harmless herbivore, it is possible that *A. avara* is an oyster predator on very young oysters on reefs in waters of fairly high salinity.

This species is common on the Sound side of the barrier islands, especially on grass flats or other habitats where the little herbivorous snail, *Bittium varium,* is present. It has also been taken in the middle of the Sound on mud bottom, but here it was living on hydroid or bryozoan colonies. None have been found along the mainland.

*Anachis obesa.* This little shell is similar to *A. avara,* but is usually solid brown and is much smaller. There are fairly numerous axial ribs and incised spiral lines in the spaces between the ribs. The narrow aperture is about half the length of the shell, and the outer lip ends in a large rounded varix. Adults are usually about 4 mm. long .

It appears to be about as common as *A. avara,* and is found in the same habitats.

*Mitrella lunata.* This is a small smooth species about the same size

as *A. obesa*. The aperture is shorter and there are brownish markings on a greenish gray background. The only sculpture is a few incised lines on the siphonal canal.

*M. lunata* is found in the same area as the two preceding species, but does not appear to be as common.

## BUCCINIDAE

These are fairly large gastropods simple in appearance. Some genera look very much like *Thais* and related muricid genera; however, the operculum is different. The nucleus in this structure is lateral in the Muricidae, but is terminal in the Buccinidae.

*Cantharus cancellarus*. The shell has a simple fusiform shape. The inside of the aperture is white, and there is a prominent knob on the columella where the siphonal canal begins. Sculpture consists of low axial ribs which bear spiral cords. Maximum size about 35 mm.

*C. cancellarus* is apparently able to do well on both mud and sand bottom. It is a common species in the southern half of the Sound, in the passes, and a little distance offshore from the Gulf side of the barrier islands. It is usually found in water more than ten feet deep. It seems to prefer turbid conditions.

The egg capsules are rather common objects during March, April and May. They often wash up on the beach attached to hydroid colonies, worm tubes, and clam shells. Some have been found fastened to the shell of living *Thais haemastoma*. The capsules, which have never been described, stand about 3 mm. high. There are four little spine like projections around the distal end. At one side of the top is an oval escape port, about 0.7 mm. in larger diameter. At the opposite side is an oval groove which runs down the side of the capsule. A dozen or more eggs hatch out while still in the veliger stage. The freshly liberated veliger swims by means of a pair of ciliated oval lobes. The entire animal is transparent, and the internal organs can be observed easily under the microscope. The digestive tract is well developed; and food particles can be seen rotating in the anterior portion of the stomach. The stomach at this stage resembles that of the lower herbivorous prosobranchs, and the cilia which produce the rotating movement are probably lost soon after the young snail assumes a more sedentary carnivorous existence.

The veligers swim about freely during the first day or so after hatching.

After that, however, they begin to avoid any light source, and are probably ready to take up a bottom crawling life shortly thereafter.

## MELONGENIDAE

Large carnivorous gastropods with a long slender siphonal canal.

*Busycon perversum*. This is the largest gastropod found on the Mississippi coast. The animal is sinistral, and all of the organs, including the shell, are opposite to those found in dextral species. Maximum size about 300 mm.

Since this is the only large sinistral species in this area, it is easy to identify. (The only other sinistral species, *Triphora nigrocincta*,

is even smaller than the freshly hatched young *B. perversum.*) It is a fairly rare species, and is usually taken while trawling. It has been collected in the Sound about two miles north of Fort Massachusetts, and in Dog Keys Pass.

*Busycon spiratum.* This is a similar but smaller species than *B. perversum.* Since it is dextral, it cannot be confused with the sinistral species. Until recently, it has been known as *Busycon pyrum* Dillwyn, but *spiratum* is the older name. This species has a channeled suture, a feature that has caused it to be confused with *B. canaliculata* Linné an Atlantic species not found in the Gulf of Mexico.

Living *B. spiratum* appear to remain some distance offshore along the Mississippi coast, but occasional hermit crab shells are taken in shallow water around the barrier islands.

## NASSARIIDAE

Small scavangers with long siphons. The siphon is naked, not being protected by a siphonal canal.

*Nassarius acutus.* This species has a small, rather long spired shell and rather large axial ribs crossed by spiral cords. The outer lip swells into a rather heavy varix, and the siphonal canal is hardly more than a notch. It reaches a size of about 6 mm. and is light brown in color.

This species, like *Cantharus cancellarus,* seems to prefer deeper and turbid conditions. It has not been found living on a mud substratum, however, it is one of the most common carnivores on sand bottom around the barrier islands in water usually more than six feet deep.

*Nassarius vibex.* This is a slightly larger species than *acutus.* It is colored bluish gray, and, in the adults, has a heavy parietal shield over much of the ventral part of the shell.

*N. vibex,* in contrast to *N. acutus,* lives in very shallow water in protected areas. The snails often bury in the sand just below the low tide level, and come out in large numbers when a dead fish strands on the shore. The eggs are laid in a gelatinous ribbon, and hatch out in the veliger stage.

Live specimens have been collected near the lighthouse on Ship Island, and along the north shore of Horn Island.

## FASCIOLARIIDAE

Large elongate fusiform species that may be smooth or sculptured.

*Fasciolaria hunteria.* Until recently this was known as *Fasciolaria distans* Lamarck. It is smooth, and has a color pattern of widely spaced, distinct, brown lines.

A few dead shells are found around the barrier islands.

## OLIVIDAE

Small, slender, brightly polished shells with the soft parts modified for plowing through the sand. The two Mississippi genera are distinguished by the possession or lack of an operculum, absent in *Oliva* and present in *Olivella.*

*Oliva sayana.* This is a slender, polished shell with a long nar-

row aperture. There is a siphonal notch and a long naked siphon as is usual in the sand burrowing Neogastropoda. Maximum size about 80 mm., but specimens are seldom more than 50 mm. long on the Mississippi coast.

*O. sayana* lives buried beneath the surface of the sand and is a common species in shallow water along the Gulf side of the barrier islands. It is a scavenger and has been taken feeding on dead fish. They are sometimes caught on a hook and line as they attempt to eat the bait. It is not known whether they actively attack living animals, or if they swallow small organisms living in the sand.

Young shells of *O. sayana* look very much like *Olivella,* but they have a longer aperture which does not open as widely at the anterior end as it does in *Olivella.* Specimens under six or seven mm. differ mostly from *Olivella* in the larger size of the apical whorls.

This species is found in the Sound near the passes, but it does not venture very far from high salinity waters and clean sand bottom.

*Olivella* sp. This is a thin, slender species. The color is white with brown markings. Maximum size about 12 mm.

A few specimens have been collected in Dog Keys Pass and on the Gulf side of Ship Island.

*Olivella mutica.* This is a fairly large, fat, brightly colored species. Maximum size about 16 mm.

The specimens collected so far were trawled in Dog Keys Pass. Specimens collected several years ago in south Florida have dried, and bits of the remains of the animals have accumulated in the small box in which they were kept. One somewhat larger mass appears to have been the stomach contents of one specimen. This mass consists of one minute pelecypod and several ostracods, and apparently this constitutes typical food of *Olivella.*

*Olivella pusilla.* This looks very much like a miniature *Oliva savana.* However, the aperture is only half the length of the shell, and the nucleus is rounded and not protruding. Maximum size about 7 mm.

The specimens collected came from trawling about one-half mile south of Ship Island. It is apparently fairly abundant a little distance offshore.

## VOLUTIDAE

Large, brightly colored shells. Western Atlantic species are generally smooth or polished, with little or no sculpture.

*Scaphella junonia.* The shell is white or cream colored, and is further provided with about a dozen spiral rows of large brown spots. The aperture is long and narrow. The animal is active, mottled black and white, and does not have an operculum.

*S. junonia* usually lives outside the area covered in this study. It is mentioned here because occasional strays probably wander inshore to within a mile or so of the barrier islands. A few shells are found on the beach after storms.

## CANCELLARIIDAE

Small to medium sized gastropods, typically with both axial and spiral sculpture.

*Cancellaria reticulata.* This is a medium size gastropod with both axial and spiral sculpture. The color is white except for large brown blotches. The columella has three folds, the posterior being the sharpest and most prominent.

*C. reticulata* appears to be very rare on this coast. One specimen was taken by trawling in Dog Keys Pass.

## TEREBRIDAE

*Terebra concava.* This is a fairly small species with a maximum size of approximately 20 mm. There are numerous short axial ribs just below the suture; but the remaining two-thirds of the whorl is smooth and concave.

This species does not appear to be common in this area, for only a few specimens have been collected in Dog Keys Pass.

*Terebra dislocata.* There are numerous short axial riblets below the suture; below these is a spiral groove, and on the remaining two-thirds of the whorl are equally numerous axial ribs which do not line up with the riblets below the suture. Maximum size about 50 mm.

This is a fairly common species on clean sand bottom around the barrier islands wherever the salinity does not drop very low.

*Terebra salleana.* This has been known until recently as *Terebra cinerea* Gmelin, but Abbott (1954) pointed out that *T. cinerea* is a West Indian species with somewhat similar shape and structure. The shell of *T. saleana* is a bluish gray color, and attains a size of about 30 mm. There are numerous, low, rounded, axial riblets just below the suture, but the remainder of the whorl is smooth except for a few fine, interrupted, spiral lines.

This is the most common *Terebra* on the Mississippi coast. It lives in shallow water on the Gulf side of the barrier islands, and during calm summer weather it moves up into the zone occupied by the surf clam, *Donax variabilis.*

## TURRIDAE

The shells of this family are usually long and slender, and usually have a distinct oval notch at the posterior end of the aperture.

*Kurtziella cerinella.* This is a small species with a slender, elongate shell which appears to be rather common in this area. The sculpture consists of nine or ten axial ribs per whorl, and many fine, rough, spiral cords that give the shell a frosted appearance. Maximum size about 8 mm.

Specimens have been found in beach drift from the south side of the barrier islands, and from bottom debris trawled in Dog Keys Pass.

*Rubellatoma diomedea.* This is a slender shell with about ten rounded axial ribs on the body whorl. The coloration consists of two spiral brown bands with a pale zone in between. Maximum size about 10 mm.

One dead specimen was taken about one half mile south of Ship Island opposite Fort Massachusetts.

*Nannodiella melanitica.* This little shell has a very heavy varix which makes the spire look very slender. The anal notch is large

and is angled off about ninety degrees from the main axis of the shell.

One dead specimen was taken in Dog Keys Pass.

## ACTEONIDAE

In this family of primitive opisthobranchs, the shell is very similar to those found in prosobranchs. The animal has an operculum and even retains the figure 8 nervous system.

Members of this family have thin, diaphanous shells. They are burrowing forms and have a well developed head shield.

*Acteon punctostriatus.* This is a small white species with revolving, punctate, incised lines on the lower portion of the whorls. Greatest length attained is about 6 mm.

A dead specimen was obtained in a bottom sample from Ship Island Pass.

*Haminoea antillarum.* This species has a greenish, rounded shell with a rather wide aperture. The animal is larger than its shell, and does not seem to be able to retract entirely within it. Maximum size about 18 mm.

A few live specimens have been collected on grass flats in one to three feet of water on the north side of Horn Island. There is no radula, but there is a gizzard-like organ provided with three stout plates for crushing small shelled organisms.

*Haminoea succinea.* This is very similar to the preceding species, but the shell is smaller and narrower. The sides of the shell are almost straight, not rounded as in *H. antillarum.* Maximum length about 10 mm.

About twenty living specimens were collected in July, 1959, in water approximately four feet deep near Fort Massachusetts, Ship Island.

## RETUSIDAE

This family consists of small white shells in which the narrow aperture is about as long as the shell. Although members of this family are burrowers, the animals can retract completely within the shell. The radula has been lost.

*Retusa canaliculata.* The minute larval whorls, when present, are at right angles to the main axis of the shell. Spire moderately long. Maximum size about 5 to 6 mm.

This is a fairly common species around the barrier islands in sand, but it is usually overlooked due to its small size. Their diet consists of Foraminifera, which are swallowed whole and crushed in the gizzard. Apparently these snails can exist in salinities down to 20-25 parts per thousand, for several live specimens were brought up in a bottom sample two miles south of the east end of Deer Island.

## ACTEOCINIDAE

The small shells of this family are very similar to the preceding one, but the animals do have a radula.

*Cylichna bidentata.* This species is slightly smaller than *R. canaliculata,* and differ in that as the shell grows the whorls extend up

over the spire and completely cover it. Thus, the aperture is as long as the entire shell. Maximum size about 3 mm.

A few specimens have been found in beach drift on Ship Island. It, too, is a sand dwelling foram feeder, but it has not been found in lower salinity water near the mainland.

## GASTROPTERIDAE

This peculiar family has an entirely internal shell, and swims with two large wing-like flaps.

*Gastropteron rubrum.* This little species has a head shield, as is common with burrowing forms, but is also provided with wing-like parapodia. The minute shell is internal, and a narrow foot enables the animal to crawl on the bottom. Maximum size about 25 mm., but the Mississippi specimens are all considerably smaller than that.

All specimens were taken in plankton tows made by J. Y. Christmas during the first four months of 1959. They have not appeared in the plankton at other times. A few specimens were taken in the Sound, but most were captured in the open Gulf to the south of the barrier islands.

## PYRAMIDELLIDAE

The Mississippi members of this family are small, white, and rather elongate. They are ectoparasites, and one species has been found to be a common parasite of the commercial oyster.

*Odostomia impressa.* A small elongate species with spiral sculpture of four revolving ridges. A generic character is the single revolving ridge on the columella. Maximum size range about 5 mm.

This species is usually found associated with its host, the common oyster, *Crassostrea virginica.* It is usually overlooked due to its small size, but the writer has found as many as seven on one oyster. It is not found in very low salinities, but it appears to do well down to 20 parts per thousand and probably down to 15 parts per thousand. It is fairly common on oysters in Mississippi Sound. It is listed in the Grand Isle Checklist (Behre, 1950) as O. *trifida* Totten.

*Odostomia seminuda.* The shell is not quite as elongate as is that of O. *impressa,* and there are fine axial lines which gives the spiral ridges a somewhat knobby appearance. It attains a length of 4 mm.

One specimen has been collected from Dog Keys Pass.

*Odostomia* sp. This is a slender minute species with numerous axial riblets, and with several spiral ridges on the base of the shell. Maximum size about 1 mm.

This species is rather common in sand and debris from the bottom of Dog Key Pass. As yet, it has not been related to any described species of *Odostomia* from the western Atlantic. It is only known from Dog Keys Pass.

*Turbonilla conradi.* In the genus *Turbonilla,* the larval whorls are pimple-like, and are generally set at a considerable angle from the main axis of the shell. There is no ridge on the columella. Usually, there are numerous axial riblets and fine incised spiral lines. *T. conradi* is typical in these respects, and has about a dozen spiral lines to the whorl. It is a very slender shell that attains a length of about 10 mm.

One specimen came from a depth of approximately 25 feet, just south of Ship Island.

*Turbonilla* sp. This is a much stouter species than *T. conradi*. It is the same length, but has only half the number of spiral lines per whorl.

The taxonomic confusion reigning at present in the genus *Turbonilla* has produced great difficulties in identification. For the present, at least, this species will be left nameless until a name can be applied to it with some certainty.

Two specimens were trawled in Dog Keys Pass.

## APLYSIDAE

This is a family of large naked herbivorous gastropods.

*Aplysia willcoxi*. This is a rather large animal that attains a length of 200 mm. The head bears four tentacles. The last pair is large, and stand nearly vertical; from this it is easy to see how the name "sea hare" came into being. There is an elongate crawling foot, and a pair of fleshy parapodia meet over the back. The shell is thin flexible noncalcified plate over the viscera, and is completely internal. The color is a mottled brown.

One specimen was collected at the east end of Deer Island on October 4, 1957, and seven small specimens were trawled off the north side of Horn Island in June of 1959. It is apparently not abundant on this coast.

## CAVOLINIDAE

This family of "sea butterflies" has shells that have lost their spiral coiling, and appear to be bilaterally symmetrical.

*Cavolina longirostris*. The shell of this species is made up of two convex plates which are united posteriorly. The lip of the ventral plate is long and slender, and protrudes considerably beyond the dorsal. The foot is divided into two lobes which propel the animal through the water. It reaches a length of 9 mm.

A few specimens have been collected in beach drift on the barrier islands.

*Cresis acicula*. This is a slender tube which is closed at one end. Maximum size about 30 mm.

This species is found in beach drift, and has also been taken alive in a plankton tow in Dog Keys Pass. It has been reported before in the inshore waters of the Gulf by Moore (1958).

## POLYCERIDAE

Slug-like nudibranchs with non-retractile branchiae in a circle near the posterior end of the dorsum.

*Polycera hummi*. This is a rather small species which may reach a length of about 20 mm.

One live specimen was collected off the Biloxi beach in four feet of water by Captain L. Arbon, of Keesler Air Force Base.

## CORAMBIDAE

Small nudibranchs in which the oval dorsum covers the entire animal.

*Corambella barataríae.* The only projections on the dorsal side are the retractile rhinophores. The branchiae consist of two pair of plates between the dorsum and the foot at the posterior end of the body. Maximum size about 4 to 5 mm.

Several specimens have been found on rocks near Fort Massachusetts on Ship Island. It is easily overlooked due to small size and inconspicuous appearance, and actually may be fairly abundant.

## ARMINIDAE

The branchiae in this family are ranged on each side of the body beneath the lateral edges of the dorsum.

*Armina tigrina.* The dorsum is black with numerous narrow white longitudinal stripes. Maximum size about 50 mm.

Specimens have been taken several times in trawls in Dog Keys Pass, once in the Sound about one mile north of Dog Keys Pass, and once about a mile south of the west end of Horn Island. Several specimens were also taken in the middle of the Sound on two different trawling trips.

## SCYLLAEIDAE

In this family large numbers of minute branchiae are found on the dorsal surface.

*Scyllaea pelagica.* This is a mottled brown white species with a very narrow foot and with two pair of dorsolateral extensions of the dorsum. Maximum size about 40 mm.

This species, which is strictly pelagic, lives on the oceanic drifting algae, *Sargassum.* It has been found once by the writer on the beach at Ship Island after a gale in June, 1956. This is only an occasional visitor at our shores, but it probably washes ashore during nearly every strong wind from the south and south-east.

## FLABELLIDAE

This family has no branchiae. Instead, a series of club shaped cerata are ranged down the dorsum.

*Eubranchus* sp. There are four rows of cerata on this brightly colored little nudibranch. Maximum size about 6 to 8 mm.

Nudibranch taxomony south of New England is almost entirely neglected. Until more work is done, it is best to leave this species nameless. Specimens usually show up in aquaria in the Gulf Coast Research Laboratory during the winter months. They apparently come through the salt water system in the veliger stage.

## ELLOBIIDAE

This is a family of small primitive pulmonates living in salt marshes and mangrove swamps.

*Melampus bidentatus.* This is a small cone shaped species with a low spire and long narrow aperture. There are two plicae on the anterior portion of the columella and a half dozen denticles on the inside of the outer lip. Maximum size about 12 to 14 mm.

This species was found to be abundant along the edges of the

small boat harbor in Ocean Springs. It has also been found in marsh grass along the edge of Davis Bayou and along the edge of ponds on Horn Island. It appears to be a detritus feeder, and the fecal pellets, oddly enough, have sand grains interspersed at intervals.

## DENTALIDAE

This family has slender curved shells shaped like an elephant's tusk. They are open at both ends, the posterior opening serving as an exit for respiratory currents.

*Dentalim texasianum.* A small white species which is hexagonal in cross section. Largest size attained is approximately 35 mm. It is very thick shelled.

This species has been found in beach drift on both Ship and Dauphin Islands. It does not appear to be very common.

*Dentalium eboreum.* This is a very slender and thin shelled species, and is circular in cross section. Maximum length about 60 mm.

One specimen has been found in beach drift from Dauphin Island.

## NUCULANIDAE

This family contains the most primitive pelecypods found on the Mississippi coast. The shells are small, white, and have many sub-equal teeth in the hinge.

*Nuculana acuta.* This species has a yellowish white shell with concentric ribs. The anterior end is rounded, but the posterior is longer and pointed. Maximum size about 10 mm.

Specimens have been found in beach drift from the barrier islands, and three live specimens were found in a bottom sample from near the east end of Deer Island. It is a rather abundant species offshore in shallow Gulf waters.

## ARCIDAE

In this family, the species are usually larger than in the preceding family, and the hinge is straight or nearly so, and has many more teeth. Although most species are white, a few are colored.

*Anadara brasiliana.* This species is white, has 26 to 28 radial ribs, and, on the ribs, there are strong bar-like beads. The left valve overlaps the right. Maximum size about 60 mm.

This species is common in the beach drift on the Gulf side of the barrier islands. It apparently does not penetrate very far into the Sound.

*Anadara ovalis.* This species has 26 to 35 square smooth ribs, and is rounded in outline. Maximum size about 60 mm.

This species has a greater resistance to lowered salinity than the other arcids in this region. One large live specimen was taken in a trawl off the west end of Belle Fontaine Point, and other live and dead specimens have been collected at the Gulf Coast Research Laboratory Station III, in the middle of the Sound. In addition, young specimens are often found in grass and algae from the grass flats on the north side of the barrier islands. It is also a common shell in beach drift on the barrier islands.

*Andara transversa.* This little shell is transversely oblong in shape,

and has 30 to 35 ribs on each valve. The left valve overlaps the right valve. The ribs on the left valve are usually beaded, but are seldom beaded on the right valve. Greatest length is about 25 to 30 mm.

This little clam is very abundant in grass and algae on the north side of the barrier islands, and attached to various objects in the deeper waters of the Sound. It, too, is found in beach drift on the barrier islands.

*Noetia ponderosa.* The posterior muscle scar is raised on a weak flange. The ribs, 27 to 32 per valve, are square and are split down the middle. The periostracum is black and exceptionally thick.

*N. ponderosa* is a fairly common shell on the barrier island beaches but apparently does not live in the Sound.

## MYTILIDAE

The mussels are thin shelled elongate pelecypods which attach to objects by means of a byssus.

*Amygdalum papyria.* This is a smooth, very thin shelled species colored pale green and light brown. It builds a nest for itself with a large supply of byssus threads. It reaches a maximum size of approximately 30 mm.

This little mussel lives on mud bottom in the Sound. It has been trawled at Gulf Coast Research Laboratory Station III, and has also been found on Biloxi beach after stormy weather. Small dead specimens have also been found in a bottom sample in outer Biloxi Bay, between Marsh Point and Deer Island.

*Brachidontes recurvus.* This is a grayish black species with numerous wavy ribs. The anterior end is strongly hooked. Maximum length about 60 mm.

This mussel is often found on oyster reefs, and in some places must be a serious competitor with the oyster for food. Although usually found attached to oysters, any hard substratum will do if other conditions are favorable. It is found in roughly the same area as the common oyster in Mississippi Sound and in the bays and bayous along the mainland.

*Lithophaga bisulcata.* This is a slender light brown cylindrical species that burrows into calcareous structures. The anterior end is rounded, but the posterior end is pointed. An oblique indented line divides each valve into two sections. Maximum size about 45 mm.

This is probably the species listed in the Grand Isle Checklist as *L. antillarum* d'Orbigny, a common species in the southern Gulf, but not known north of south Florida. Being forced to bore into shells by the lack of calcareous rocks, *L. bisulcata* is not too successful in this area. Living specimens have been found in shell debris trawled in Dog Keys Pass, and in oyster shell from an old wreck off the north side of Ship Island. It does not penetrate far into lower salinity waters, and is not found living in the Sound except close to the barrier islands.

*Modiolus demissus.* This is a large shiny dark brown mussel, with many strong radial bifurcating ribs. It is similar to *Brachidontes recurvus,* but does not have the hooked anterior end, and the habitats of the two species are also quite different. Maximum size about 100 mm.

This species is large enough to be of commercial importance if a demand were to develop that would make collecting them worthwhile. In the Mississippi area, it is usually found at lower salinities than is *B. recurvus*. It lives intertidally among the roots of the marsh grass, *Spartina*, and is common in the bays and bayous of the mainland. The byssus is firmly attached to the main stem or root of the grass, and it is difficult to remove the mussel without some sort of digging tool. It is sometimes quite abundant, but in a very narrow restricted environment.

*Musculus lateralis*. This is the smallest of the family in Mississippi. It is characterized by radial ribs on either side of a central smooth area. Maximum size about 8 mm.

This is a marine species which is, however, found in the Sound on the rocks and grass flats on the north side of the islands. It is usually overlooked due to its small size, but is probably fairly abundant on the grass flats.

## PINNIDAE

This is a family of large thin shelled bivalves. The anterior end is reduced, narrow, and pointed, the posterior is large and rounded. It lives buried in the sand or mud with just the tips of the posterior ends of the valves protruding.

*Atrina seminuda*. This species has a few (5 to 16) radial ribs which may be smooth or carry spines. The spines, if present, are fairly large. Maximum size about 240 mm.

This is not a common species on the Mississippi coast. One fresh dead specimen was collected in a depth of about 10 feet of water on the north side of Horn Island during the summer of 1959. A live specimen was collected in shallow water near Fort Massachusetts a few weeks later.

*Atrina serrata*. This is a more thin shelled species than the preceding. The sculpture consists of about 30 inconspicuous ribs which carry many fine imbrications. Maximum size about 300 mm.

A few specimens are found from time to time in deeper water along the north side of the barrier islands. It must be fairly abundant just offshore on the Gulf side of the barrier islands, for many are washed ashore after strong winds and high waves.

## PLICATULIDAE

This is a family of small attached, oyster-like, bivalves. The ligament, however, is internal, and there is a hinge tooth on each side of it.

*Plicatula gibbosa*. There are five to seven strong radial ribs which give the valves an interlocking margin. Maximum size about 30 mm.

One live specimen was taken in the trawl at Dog Keys Pass.

## PECTINIDAE

The scallops have a rounded outline except for the straight hinge line. They are unusual pelecypods in that they can swim and have eyes on the edge of the mantle.

*Aequipecten irradians*. This scallop has 12 to 21 radial ribs. The

dorsal valve is mottled brown and gray, but the ventral is usually pure white. Maximum size about 75 mm.

This is the common edible scallop on the Atlantic and Gulf coasts. It is quite common on the west coast of Florida and there is a small fishery in Tampa Bay, however, it is not abundant on the Mississippi coast. A few specimens can be found on the barrier island grass flats occasionally, and on October 14, 1956, W. J. Demoran collected about 35 specimens near Fort Massachusetts. There appear to be extensive beds of this scallop in the Chandeleur Islands, but no report has been published as yet on their abundance.

## OSTREIDAE

This family of attached bivalves contains the edible oysters, but not the so-called pearl oysters.

*Crassostrea virginica.* This is the common edible oyster that is of such economic importance. Oysters are extremely variable in size and shape; a result of varying environmental conditions. The outside of the shell is usually a dirty gray, and the inside is white with purple muscle scar. Maximum size close to 300 mm.

The value of the Mississippi oyster fishery catch in 1957 was $185,402. This figure is based on the production of the large oyster houses, and does not include those taken by individuals working on a small scale. In addition to the living oysters, dead reefs are dredged to provide large quantities of calcium carbonate for various industrial purposes on the Gulf coast. Large quantities of fresh shell are utilized for drains, driveways, and similar purposes.

The most extensive oyster reefs on the Mississippi coast are in the Sound off Pass Christian, but scattered patches are common in the bays and bayous. Another fairly extensive reef is at the east end of the Sound between Point Clear and Dauphin Island in Alabama waters. Oysters are common on pilings and other man made structures, and in the southern portion of the Sound. Large oysters have been found on pilings close to Horn Island and on the remains of an old wreck close to Ship Island. They have also been found on the remnants of an old dock jutting into the Gulf on the east end of Ship Island. It is an abundant species, but its numbers have declined due to fishing pressure and other causes.

*Ostrea equestris.* This little oyster is a high salinity form so it is not often found with the commercial oyster. It differs from *C. virginica* in that the muscle scar is near the center of the shell and is not colored. The interior of the shell is not white, but is usually grayish or greenish. There is a row of denticles on each side of the hinge.

A few specimens have been trawled in Dog Keys Pass attached to broken shell.

## CRASSATELLIDAE

This is a family of rather primitive burrowing clams without siphons. The ligament is interior, and there are two or three strong hinge teeth in each valve.

*Crassinella lunulata.* This is a small, compressed, subtriangular species with two cardinals and one lateral in each valve. Dorsal

margins are straight and about 90 degrees to each other. Concentric sculpture consists of about 15 coarse, well developed ribs.

This little sand dweller appears to be rare in this region. It occasionally washes ashore on the Gulf side of the barrier islands, and two live specimens have been brought up in bottom samples in Dog Keys Pass.

*Cuna dalli.* This clam is one of the smallest species to be found on the Mississippi coast. The shell is subtriangular, and has fine concentric sculpture. There are three cardinals in each valve and an internal ligament. The two muscle scars are subequal, and the pallial line is simple. The color is purple. Maximum size about 2 mm.

This little clam was reported as being extremely common on the beaches of Dauphin Island by Moore (1957). Since then it has been found living in shallow water at the west end of Horn Island. It lives at a depth of several millimeters in fairly coarse sand. Some of the sand grains are larger than adult C. *dalli,* but this does not appear to impede the movement of the little clam.

The writer collected living specimens for study by running his fingers through the sand, then picking up individual clams that were brought to the surface by the disturbance. Some were kept alive in the Laboratory for a few days, but did not do well in still water and soon died. For the first two or three days, however, they were quite active, and ploughed around in the sand several millimeters beneath the surface. While being observed by the writer, one gave birth to a single young. This young specimen, which was approximately 300 microns in length, immediately began to burrow into the sand.

C. *dalli,* appears to be confined to the northeastern Gulf between Apalachicola, Florida and eastern Louisiana. West of the Mississippi River, the grain size of the sand is much smaller, and seems to be unsuitable for the existence of the species. The Gulf coast of Florida to the east of the Apalachicola area is protected from wave action by the broad shallow shelf, and open wave swept beaches are not to be found. C. *dalli,* apparently, will not survive in this type of environment. Where the environment is favorable, however, such as the area between Dauphin Island and Sand Island at the mouth of Mobile Bay, C. *dalli* can live in vast numbers.

## CARDITIDAE

Small, heavy, thick ribbed, elongate clams.

*Cardita floridana.* This species is twice as long as high, and has about 20 strong beaded radial ribs. Maximum size about 35 mm.

Single valves are found occasionally in beach drift from the barrier islands, but none have been found living in this area.

## CORBICULIDAE

This is a family of fresh or brackish water clams. They are usually oval in shape, and have two or three cardinal teeth in each valve.

*Polymesoda caroliniana.* The shell is oval and is covered with a fuzzy periostracum. There are three small, nearly vertical cardinal teeth in each valve. There are also two lateral teeth in each valve.

About a dozen specimens were collected by geology students in the summer of 1958 from mud thrown on the bank of Fort Bayou by dredging operations. This locality is several miles up the bayou from Biloxi Bay, where the salinity is always quite low. It is common in Halstead Bayou, a small marsh drainage stream near the Laboratory.

## DIPLODONTIDAE

This is a family of rounded, inflated white clams with a pair of cardinal teeth in each valve. They do not ordinarily drill holes, but like to nest in holes and cavities left by other animals.

*Diplodonta punctata.* This species is quite inflated, pure white, and has very fine concentric sculpture. Maximum size about 18 mm.

Five living examples of this species were taken in a small brick pile about 100 feet east of Fort Massachusetts on Ship Island. Rosso reported a *Diplodonta* (1952) from the same locality. He thought that it was *D. soror* C. B. Adams, but, if his species is the same as the writer's, it does not fit the description of *D. soror.*

## LUCINIDAE

This family consists of thin, usually white clams without siphons and weak or obsolete hinge teeth. The anterior muscle scar is long and narrow.

*Lucina amiantus.* This is a small obese species sculptured with 8 or 9 wide radial ribs. Across the ribs run numerous small concentric riblets. Maximum size about 8 mm.

Shells of this little clam are fairly common in beach drift from the barrier islands, but it has not been collected alive by the writer. It may live in deeper water a little distance offshore.

*Lucina floridana.* This is the largest *Lucina* found in the region. It is thin and compressed and with no sculpture except occasional growth rings. Maximum size about 45 mm.

This is a fairly common species in the grass flats on the north side of the barrier islands. The grass flats three to four miles from the west end of Horn Island have been an especially good collecting area.

*Lucina multilineata.* This species is similar to *L. amiantus,* but is without the radial ribs. It often continues growing after a rest period which causes a concentric hump in the shell. Maximum size about 8 mm.

Single valves are fairly common in beach drift from the barrier islands.

## CHAMIDAE

Members of the Chamidae have heavy inequivalve shells that are fixed to the substratum.

*Chama congregata.* This is a fairly thick species which is attached by the left valve. The fixed valve is larger and deeper than the upper valve. There is one hinge tooth in each valve, and numerous small denticles are found all around both valves.

As yet, only one small live specimen from Dog Keys Pass has been collected.

## LEPTONIDAE

This is an odd family of small clams. The foot in many has reacquired a flattened sole, and they glide around like typical gastropods. There is a special anterior inhalent siphon, but the water is expelled behind in the usual manner. Some are commensal or parasitic.

*Kellia suborbicularis.* The shell is glassy, thin, and inflated. The outline is rounded, and there is one tooth in the hinge of each valve. Maximum size about 2 mm.

One live specimen measuring 1 mm. was found in sand and shell debris from Dog Keys Pass.

*Mysella cuneata.* There are two cardinal teeth in the right valve, none in the left. It is distinctly triagonal in outline. Maximum size about 3 mm.

Single valves have been found in shell debris brought up by the trawl in Dog Keys Pass.

*Mysella planulata.* This species is oval oblong in outline. The anterior end is longest. Maximum size about 3 mm.

This species has been found in beach drift from Dauphin Island and Horn Island, and also from shell debris in Dog Keys Pass.

## CARDIDAE

The hinge in this family usually consists of a strong cardinal and two laterals. The shells are usually much inflated, and may be quite large.

*Dinocardium robustum.* This is by far the largest of the family in this area. It is ovate, inflated, and bears about 35 radial ribs. Maximum size about 100 mm.

Dead shells are common on the barrier island beaches, and many have been taken in the trawl in Dog Keys Pass. The trawl, however, does not dig into the sand, and only one live specimen has been collected by this device. *D. robustum* seems to be fairly abundant around the passes, and off the barrier islands. It apparently does not penetrate into Mississippi Sound, or, if it does, only a short distance from the passes.

*Laevicardium laevigatum.* Fairly large, inflated, smooth and obscurely ribbed, this species may be up to 60 mm. in size.

A few dead shells have been found in the grass flats on the north side of Horn Island. Live ones have not been collected.

*Laevicardium mortoni.* This is a smaller but similar species that differs from *L. laevigatum* in the color pattern of brown zig-zag markings and minutely pimpled concentric ridges. Maximum size about 25 mm.

Occasional living specimens are found in shallow water (2 to 4 feet) on the Sound side of Horn and Ship Island.

## VENERIDAE

This is a family of many species of burrowing clams. The shells are solid and porcelaneous, and have three diverging cardinal teeth in each valve.

*Callocardia texasiana.* This is a white, thin shelled species with fine concentric sculpture. Maximum size about 80 mm.

Abbott (1954) states "Uncommon, if not rare. Found on the beaches, but its biology and habits are unknown."

About a dozen live specimens have been collected in trawls in Mississippi Sound. All specimens were living in soft mud in the central part of the Sound, either between Biloxi and Ship Island or between Bell Fontaine Point and Dog Keys Pass. The reason for the distribution found is that the Laboratory vessel "Hermes" usually goes to either Horn or Ship Island on field trips. Trawling almost anywhere on mud bottom in the deeper parts of the Sound should produce these clams. It is easy to see why clams living in this sort of environment are not often found on the beach. It is propably fairly common both in offshore and inshore waters in similar localities in the northern Gulf.

*Chione cancellata.* This is a medium size ovate shell with both concentric and radial ribs. Maximum size about 45 mm.

A few single valves have been found around the barrier islands, but no live or even fresh dead specimens have been collected. Possibly it was once established here, but died out due to adverse physical conditions.

*Chione grus.* This is a small oblong species with 30 to 40 fine radial ribs which are crossed by very fine concentric threads. There is purple color on the hinge at both ends. Size about 8 mm.

This species is apparently common, but is usually overlooked due to its small size and to its habits. The writer has not found it burrowing in sand or mud; instead, it has been found living in sea weed on rocks and similar habitats.

*Chione intapurpurea.* This species is very similar to *C. cancellata,* but it has concentric sculpturing only. The lower edges of the ribs bear many small bars which line up to give the impression of radial ribs. Maximum size about 40 mm.

Single valves are fairly common on the barrier island beaches, but only one live specimen has been taken in Dog Keys Pass.

*Dosinia discus.* The shell is circular, compressed, and white with a thin yellowish periostracum. Sculpture consists of numerous, fine concentric ridges, about 50 to the inch. Maximum size about 70 mm.

Both single and fresh double valves are commonly washed up on the barrier island beaches. It apparently does not live in the Sound.

*Gemma gemma.* This is one of the smallest members of the family. The shell is subtrigonal, somewhat inflated and has numerous fine concentric riblets. Maximum size about 3 mm.

This specimen is superficially similar to *Cuna dalli,* but has an external ligament and a large faintly impressed lunule. It is like *C. dalli* in that it broods its young, which emerge as replicas of the adult. It is often pure white, but some specimens are purple which increases the resemblance to *C. dalli.*

This little clam lives in sand on both sides of Mississippi Sound. A number of live specimens have been taken by screening sand on the east end of Deer Island. Other specimens have been collected close to shore on the north side of Horn Island. It does not appear to be common here.

*Macrocallista nimbosa.* This is an elongate compressed species without sculpture. The exterior is glossy, smooth, pale brown with broken radial bands of darker color. Maximum size about 130 mm.

Three or four live specimens have been found in shallow water on the north side of Ship Island near Fort Massachusetts. It appears to be rather rare in Mississippi waters as it seems to prefer shallow protected sandy areas where many would be found if it were at all abundant.

*Mercenaria mercenaria.* Large ovate-trigonal and thick shelled, this species has long been known as the hard shell clam or quahog. There are three cardinal teeth in each valve, and the middle cardinal in both is split. External sculpture consists of numerous concentric growth rings which usually coalesce to form irregular flat topped ribs.

Although common in some Gulf localities, this species appears to be rather rare in Mississippi. A few live samples have been collected on the north side of Horn and Ship Island in sand. Several beds of *M. mercenaria* have been reported from the Chandeleur Islands, Spaulding (1906), but it is not known if these beds still exist. Since this species is the chief constituent of clam chowders, the discovery of large beds could be of commercial importance.

*Parastarte triquetra.* This little clam is about the size of *Gemma gemma,* but is different in appearance. The shell is higher than long, and the exterior is smooth and highly polished. The color is some shade of brown. Maximum size about 3 mm.

One quite fresh valve was collected in shallow water on the north side of Horn Island. It was neatly drilled by some small predatory gastropod. A few worn dead valves have also been found in shallow water on the north side of Ship Island.

## PETRICOLIDAE

Members of this family are usually elongate, and burrow into rock and clay. The hinge teeth are similar to the Veneridae, but there are no laterals.

*Petricola pholadiformis.* This is an elongate, fragile, chalky white species. There are numerous radial ribs, an external ligament, and long pointed cardinal teeth. This clam has considerable similarity in appearance to some of the Pholadidae, especially to *Cyrtopleura costata* Linné and to *Pholas campechiensis* Gmelin.

Single valves are fairly common in beach drift on the barrier islands. The writer has not collected living samples, but Dr. J. F. Walker has collected living specimens from the Gulf side of the eastern half of Ship Island, and a graduate student, Bennie Rohr, has found living material at Belle Fontaine Point on the mainland.

## TELLINIDAE

Members of this family have long slender separate siphons, and a long and powerful foot. The shells are usually compressed and elongate, and the sculpture, if present, is made up of very fine ridges.

*Macoma constricta.* This is a medium sized, ovate species with a somewhat pointed posterior end. This end is also strongly twisted to the right. The color of the shell is white, but it is covered by a thin grayish periostracum when alive.

This is a euryhaline species which lives in sand on both sides

of Mississippi Sound. Although it may live just off the beach in some Texas localities, it does not appear to do so on the Mississippi coast. It is apparently most abundant on the mainland side of the Sound in such sandy areas as the east end of Deer Island and Belle Fontaine Point. A few specimens have also been taken at the tip of Marsh Point in Biloxi Bay.

*Macoma mitchelli.* This is a small elongate clam with a nearly straight ventral line having a slight twist to the right. Live specimens have a thin periostracum which gives a smooth, glossy iridescent sheen to the shell. The maximum size is about 20 mm.

This species is common in muddy bottom in Davis Bay where it was collected in numbers, by the author and Dr. J. P. E. Morrison. It should be found in mud or muddy sand in many localities along the mainland.

*Strigilla mirabilis.* This is a white, oval, inflated clam with peculiar sculpture. There are many fine, oblique cut lines which meet the ventral edge at an angle of about 45 degrees. Maximum size about 9 mm.

This is a common species in the beach drift on the barrier islands. It does not appear to live in the Sound.

*Tellidora cristata.* This is a white, compressed, ovate species with sawtooth crenulations on the dorsal margins. Maximum size about 40 mm.

Only one valve of this species was collected at Laboratory Station III.

*Tellina alternata.* This is an elongate solid species with an elongate somewhat pointed and twisted posterior end. Sculpture consists of numerous, evenly spaced concentric grooves. Color is whitish to pink. Maximum size about 70 mm.

Single valves have been trawled from time to time in Dog Keys Pass, but live specimens have not been taken. However, this is a large powerful burrower, and is not easily captured.

*Tellina iris* This species is somewhat elongate, thin shelled and has fine wavy oblique lines. There are two weak white internal ribs present at the posterior end. Maximum size is about 12 mm.

One live specimen was trawled in Dog Keys Pass.

*Tellina texana.* This species was listed on the Laboratory Invertebrate Checklist as *T. sayi* Dall, a synonym of *T. texana.* The writer believes that specimens of *Macoma mitchelli* were probably identified as this species.

*Tellina versicolor.* This clam looks very much like a small *T. alternata,* but has a shorter posterior end. Live specimens are iridescent.

Two specimens were brought in by trawl in sand and shell debris about one half mile south of Fort Massachusetts on Ship Island.

## SÉMELIDAE

Members of this family are very similar to the Tellinidae, but have an internal resilium as well as an external ligament. The slender separate siphons are extremely long.

*Abra aequalis.* The shell is white and rounded with small pointed umbos. There is a groove on the anterior margin of the right valve. Maximum size about 12 mm.

This little clam has been found in considerable numbers in

beach drift from the barrier islands. It has not been collected in the Sound.

*Abra lioica.* This is a somewhat smaller, very similar species which lacks the groove on the anterior margin of the right valve. Maximum size about 8 mm.

It is sometimes rather abundant in barrier island beach drift.

*Cumingia tellinoidea.* This species is oblong, thin and slightly pointed at the posterior end. It looks very much like a *Tellina.* Maximum size about 20 mm.

The writer has not found this species, but it is included because it is on the Laboratory Checklist.

*Semele nuculoides.* This is a small white species with an elongate anterior end, with the umbos very close to the posterior end. Very fine concentric ridges make up the sculpture. Maximum size approximately 6 mm.

This little clam has been taken in Dog Keys Pass and Ship Island Pass. It has also been found in barrier island beach drift. It is probably fairly abundant in a depth of two fathoms or more, but it is easily overlooked due to its small size.

*Semele proficua.* This species is almost round in outline with the beaks almost central. There is a small pushed in lunule. The sculpture consists of fine concentric lines and microscopic radial striations.

Two live specimens were collected by W. J. Demoran at the old wreck off the north side of Ship Island. These specimens were found in a dead oyster shell several feet above the bottom. This appears to be an unusual habitat for the species, but it is the only habitat found for *S. proficua* on the Mississippi coast.

## DONACIDAE

Members of this family are usually cuniform in shape with a short thick posterior end and a long tapering anterior end. The American species all live in the surf zone on open beaches.

*Donax variabilis.* This clam has an almost straight ventral margin. The inner edges of the valve are denticulate. The color is extremely variable and usually bright. The siphons are quite short. Maximum size about 25 mm.

This is the common surf clam from North Carolina to Texas. It lives along the beach in the area where the waves wash back and forth. In this habitat it is usually protected from predatory snails, although the writer once found one being bored by a *Polinices duplicatus* on a Texas beach. During the summer *Terebra saleana* moves into the same zone, but it is not known whether or not it feeds on *Donax.* The most serious predators seem to be the small beach birds, the sand pipers.

Although the vast majority of this species are found on the Gulf beaches, an occasional rare specimen is found on the Sound side of the islands. In addition, another species, *Donax tumidus,* is probably present just off the beach in knee deep water. Specimens which differ slightly from typical *D. variabilis* have been collected at Ship Island.

## SANGUINOLARIIDAE

In this family the siphons are long and separate as in the Tell-

inidae and Semelidae. They have a strong foot and can burrow rapidly into the sand. They resemble razor clams, but the beaks are located near the center of the dorsal margin.

*Tagelus plebeius.* This is an elongate species with parallel ventral and dorsal margins. The anterior and posterior margins are bluntly rounded. The color is white, but the exterior is covered by a brownish periostracum Maximum length about 80 mm.

The habitat favored by *T. plebeius* in Mississippi is muddy sand bottom and turbid water. It is common in the Sound along the mainland shore, but is seldom seen or collected alive due to the speed that it can burrow into the sand. It has been collected many times, however, by students using shovels and screens. The east end of Deer Island has proved to be a good collecting spot. It does not appear to be as common in the southern part of the Sound.

*Tagelus divisus.* This species is very similar to the preceding one, but it is a little more slender. Internally, the valves are strengthened by a weak radial rib. Maximum size approximately 40 mm.

One valve was trawled in Ship Island Pass in January, 1956.

## SOLENIDAE

Members of this family are elongate, slender burrowers in sand. They are similar in appearance to *Tagelus,* but the beaks are usually displaced toward the anterior end of the shell.

*Ensis minor.* This is the Gulf coast "razor clam." The shell is long, slender, and slightly curved. The beaks and hinge teeth are at the extreme anterior end. The shell is covered with a pale greenish periostracum. Maximum size approximately 70 mm., but specimens which might belong to this species have been found offshore in deeper water in sizes ranging to 145 mm.

*E. minor* is a common species in shallow water on both sides of the Sound. It is more common than *Tagelus plebeius,* and appears to thrive in a somewhat wider range of salinity and turbidity.

## MACTRIDAE

Members of this family usually have an external ligament as well as an internal resilium supported on a chondrophore.

*Labiosa plicatella.* This is a large, oval, thin shelled species. The anterior end is longest, and the sculpture consists of large concentric ribs which appear as grooves on the inside of the shell.

The valves of this clam are easily broken by rough weather, but a few wash up on the beach. The writer has never seen a living specimen, or even a dead one with both valves attached. It appears to be strictly marine, and does not live in the Sound. A closely related species, *Labiosa lineata* Say, has been found at North Island, Chandeleur Islands, and should be found in Mississippi in the future.

*Mactra fragilis.* This species is oval, thin, and smooth. It is pure white, but is covered by a thin brownish periostracum. The pallial sinus is rounded, and extends about halfway to the anterior muscle scar. Maximum size about 100 mm., but Mississippi specimens are usually only half that size.

It is a common species in shallow water on the Sound side of

the barrier islands. Most of the specimens the writer collected came from the extensive grass flat area on the north side of Horn Island in depths of from 2 to 6 feet. It has not been found along the mainland shore, and appears to be scarce on the Gulf side of the barrier islands.

*Mulinia lateralis.* This little shell does not have an external ligament, and there are two long slender laterals in each valve. It is very similar in appearance to young *Spisula solidissima,* but the lateral teeth are smooth whereas in *S. solidissima* there are minute vertical ridges on the laterals. *M. lateralis* is usually trigonal in shape, but there is some variation. The color is white, but a thin brownish periostracum covers the exterior of the shell. Maximum size about 15 mm.

This clam lives in sand in the protected waters of bays and lagoons. Somehow the common name "Surf clam" became associated with this species, and both Abbott (1954) and Morris (1951) use this name. However, the writer and other interested people have searched in vain for this clam in the surf zone.

This clam is distributed in Mississippi on both sides of the Sound in shallow water on sand or muddy sand bottom. It does not appear to do well if the salinity becomes low, but it has been found living in the Laguna Madre of Texas where the salinity was over 70 parts per thousand.

*Rangia cuneata.* This is a very thick, heavy, obliquely ovate species. The external ligament is absent, and the beaks are separated and rolled in toward each other. Long serrated lateral teeth extend over both the anterior and posterior adductor muscles. The exterior is white, but is covered by a fairly heavy brownish periostracum. There is a small, distinct pallial sinus. Maximum size about 60 mm.

*R. cuneata* lives in fresh to brackish water in the bays and tidal bayous where the salinity seldom goes above 15 parts per thousand. No specimens have been found as yet in the Sound, where the water is too salty, but seven live specimens were collected by Dr. J. F. Walker in a brackish water lagoon on the north side of Ship Island in July, 1949.

*Spisula solidissima.* This is a large handsome clam which, superficially, resembles *Mactra fragilis.* However, it has long slender lateral teeth which bear tiny vertical ridges. The pallial sinus is small, and reaches no more than one fourth of the distance between the muscle scars. Maximum size about 180 mm.

This handsome clam is found living on both sides of the barrier islands in fairly shallow water. Although fair numbers of shells are found, it does not seem to be very abundant on the Mississippi coast. The Gulf coast form is usually considered a subspecies of the north Atlantic form, but it may prove to be a distinct species.

## MESODESMATIDAE

These are oval or wedge shaped shells with short posterior ends. There is no ligament, but the internal resilium is supported by a chondrophore in each valve.

*Ervilia concentrica.* This little clam is somewhat elongate, and is elliptical in outline. Sculpture consists of numerous fine concentric

ridges. The color range is white, yellow, and pale pink. Maximum size about 8 mm.

This small species has only turned up as single valves in barrier island beach drift. It does not appear to be very numerous, but it is easily overlooked.

## CORBULIDAE

Small, solid clams that look very much alike. The Corbulidae are unusual in that one valve completely overlaps the other in most species. They are usually concentrically ribbed, and have a single conical hinge tooth in the right valve.

*Corbula* sp. One live specimen was collected from the east end of Ship Island; length 6 mm. The taxonomy of the West Indian members of the genus is still confused and the identity of this specimen has not yet been made.

## GASTROCHAENIDAE

Members of this family bore into rocks or into the shells of larger mollusks. The shell is chalky white, and gaps widely at the anterior end.

*Rocellaria stimpsonii.* The surface sculpture consists only of incremental lines. The anterior border is reflected outward, and there is no interior rib. Maximum size about 15 mm.

This clam appears to be fairly common in rocks and shells around the barrier islands. When individuals bore through a thin shell they form a flask shaped shelter of calcareous material. Several of these curious little structures have been found in shell debris from Dog Keys Pass.

## PHOLADIDAE

This is a family of boring pelecypods A burrow is started when the young pholad settles to the bottom, and it remains there for the rest of its life. There are no teeth in the hinge, but there is an accessory plate over the hinge area. Thin membranes unite the valves above and below the accessory plate.

*Barnea truncata.* This is a thin shelled species with long dark colored siphons. The anterior end is somewhat pointed, and the posterior is abruptly truncate. Maximum size of the shell is approximately 60 mm. The siphons cannot be retracted within the shell.

This species appears to be rather rare in Mississippi waters. Two live specimens were collected in July, 1958, by Dr. H. J. Bennett and his Marine Zoology class at the east end of Deer Island.

*Cyrtopleura costata.* This is the large and handsome "Angel Wing." The shell is usually white, elongate, and rather thin shelled, but is not as fragile as *B. truncata.* There are about 30 radial ribs which have projecting scales on the anterior portion of the shell. The valves gape considerably, and the animal is much too large to fit inside the valves. Maximum size of the shell is 200 mm., but the entire animal when relaxed in its burrow may be 400 mm. long. It usually burrows in mud, but has been found by the writer living in fine sand.

*C. costata* is found in very shallow water along the mainland shore of the Sound. An especially good collecting ground has been at the east end of Deer Island, but even here it does not seem to be abundant. Single valves are found in beach drift on the barrier islands, but no living specimens have been seen in that area.

*Diplothyra smithii.* This is a small, rounded clam that is usually found boring into oyster shells. The shell is widely gaping in young, but this open space is covered by a shelly callus after the animal reaches maturity. The exterior of the valve is divided by a sulcus, and the anterior half is sculptured by fine concentric ridges and indistinct radial ribs. The posterior half has growth lines only. Maximum size is 15 mm.

This species is easily overlooked, but is fairly common in the saltier parts of the Sound.

## TEREDINIDAE

This is a family of worm like pelecypods (the "Shipworms") that burrow into wood. The minute shell is at the deep end of the burrow, and a shelly lining for the tube is secreted by the mantle for protection. Two plume-like pallets at the posterior end of the animal can close off the burrow.

*Bankia gouldi.* The pallets are about one-half inch long. The cones have deep cups with smooth edges. The entire animal may grow to be a length of more than 200 mm.

This species bores into wood wherever the water is brackish or salty.

## LYONSIDAE

The shells of this family are small and fragile, and have a pearly lining on the inside of the valves.

*Lyonsia floridana.* This is a small elongate species with a short rounded anterior, and a long rostrate posterior end. The left valve is larger than the right, and there is a thin papery periostracum. Maximum size about 18 mm.

The writer has taken only one specimen; it was found on the grass flats along the north side of Horn Island.

## PANDORIDAE

A family of thin compressed pelecypods with a hinge of lamelliform plates instead of teeth. The beaks are very inconspicuous.

*Pandora trilineata.* This small clam is white and very compressed. The right valve is flat, but the left valve is somewhat convex. The dorsal margin is concave posterior to the beaks and slightly convex on the anterior side. The ventral margin is nearly straight, then curves up abruptly to the anterior and posterior ends of the shell. The beaks are near the anterior end. Maximum size about 30 mm.

*P. trilineata* has proved to be almost as rare as *Lyonsia floridana* on the Mississippi coast. Several specimens were found on the beach on Dauphin Island in March, 1956, but only one small specimen has been collected farther west, in Ship Island Pass.

## LOLIGINIDAE

This is a family of small, fast swimming cephalopods. The body

is torpedo shaped, and the fins are large and triangular. There are two long retractile tentacles and eight short arms.

*Loligo pealei.* This species has a slender body and long triangular fins usually slightly more than half the mantle length. Maximum size of the entire animal, including the two tentacles, may be 500 mm. or more.

*L. pealei* is a coastal marine form which does not go into waters of low salinity. Although it has been collected in Dog Keys Pass, none have been caught in the Sound away from the Pass. It is not very common in Mississippi coastal waters, but trawling just off the barrier islands will occasionally turn up a few specimens.

A similar species, *Doryteuthis plei* Blainville, has been caught about five miles south of Horn Island, and, as it probably comes closer to shore, it should be mentioned here. It has a more slender body, the fins are less triangular, and there is a flap of skin along the mid-ventral line along the length of the body. Its body dimensions are nearly the same as those of *L. pealei.*

*Lolliguncula brevis.* This small squid is somewhat similar to *L. pealei.* in appearance, but differs in its small size, short thick body, and short rounded fins. Maximum size of the animal is 250 mm.

*L. brevis* is an exceedingly common squid on the northern Gulf coast. Although all cephalopods are generally considered to be stenohaline marine animals, this species is quite common in brackish water. Gunter (1950) reported that he had found it in salinities as low as 17.7 parts per thousand. He also reported that only nine specimens out of a total of 276 were taken in salinities below 20.0. Since then, he and the writer have found it to be quite numerous in slightly lower salinities in Mississippi Sound. On April 22, 1957, eighty *L. brevis* were taken in a 20 minute trawl haul at the Laboratory Station III in a depth of 14 feet. The salinity was 12.88 at the surface, and 16.68 just off the bottom. The corresponding temperatures were 24.0° C. at the surface, and 23.2° at the bottom.

Large numbers of this little squid can usually be found almost anywhere in the deeper waters of the Sound, and it has sometimes been taken in quantity in outer Biloxi Bay. The long, tapering, gelatinous egg cases of this squid are also quite common in the central portion of the Sound.

## OCTOPODIDAE

This is a family of benthic cepahalopods distinguished from squids by the absence of tentacular arms and fins, and by having a short, rounded body instead of being torpedo shaped.

*Octopus vulgaris.* There are two rows of suckers on the arms of this species, and the first pair of arms are much shorter than the others. The gill plates number 7 to 11. Maximum length is about one meter, or a radial spread of two meters.

The Mississippi coast is a poor habitat for the octopus which prefers to live in holes and caves in rocky areas. Nevertheless, a total of four specimens have been trawled in Dog Keys Pass from 1957 through 1959.

On November 12, 1959, a small octopus measuring approximately one and one-half feet long with arms outstretched was trawled by a fisherman at about the middle of Mississippi Sound, midway between Deer Island and Ship Island. The preserved specimen was kept by the fisherman.

## SUPPLEMENTARY NOTE

Since the time that the work on the main body of this paper was done, additional material has added several more records for the area studied by the writer. In addition, Dr. J. P. E. Morrison of the U. S. National Museum worked at the Gulf Coast Research Laboratory for a period of nearly three weeks, during May and June of 1960. His collecting in this area turned up five more species not previously reported, as well as new localities for other species on the Mississippi coast. He also made a number of helpful suggestions, and supplied information not available to the author. Among other things, he pointed out that unpublished work by Dr. Alfredo do la Torre had established the genus *Alabina* Dall, 1902, as a synonym of *Finella* A. Adams, 1860. In addition, he found *A. cerithidoides* Dall, 1889, to be a synonym of *Chemnitzia dubia* d'Orbigny, 1842, so that the name of this little shell is now *Finella dubia* d'Orbigny with *Alabina cerithidoides* Dall as a synonym.

The additional species are as follows:

### GASTROPODA

### PROSOBRANCHIA

### HYDROBIDAE

This is a large family of small to minute fresh and brackish water snails. They usually have a well developed spire, and a rather heavy shell. Color is lacking, but the shell is usually covered by a brownish coating, which gives the snail a dull and inconspicuous appearance.

*Littoridina sphinctostoma* Abbott and Ladd, 1951. This little species is fusiform in shape, and without sculpture except for very faint incremental lines. Adults usually are covered with a more or less thick coating of brownish material. The aperture is oval, but has a slight groove at the posterior end. The aperture becomes abruptly smaller at maturity, and is no longer appressed to the preceding whorl. The peristome is then complete, and immature specimens appear at first to belong to a different species. There are slightly over six whorls in a specimen 3 mm. long.

This snail is common in Lake ~~Ponchartain~~ Pontchartrain, Louisiana, but it has been collected in Mississippi only at Heron Bay, just east of the mouth of the Pearl River, by Dr. J. P. E. Morrison. It lives in areas of quite low salinity, and may be found elsewhere in Mississippi near the lower end of the salinity gradient.

*Littoridina* sp. This species is about the same size as *L. sphinctostoma,* but does not have the reduced aperture found in the mature *L. sphinctostoma.* The peristome is not entire, and the preceding body whorl forms the inner posterior portion of the aperture. There is an umbilical chink, and a 3 mm. specimen had slightly more than five whorls.

The only known locality for this species is a pond on Horn Island, where it is found with *Chara,* a fresh water plant known as "stonewort." It appears to be an undescribed species, and may belong to a different genus. It will be described at some future date by Dr. Morrison.

## OPISTHOBRANCHIA
## PYRAMIDELLIDAE

*Sayella hemphilli* Dall, 1883.

This is a small, somewhat elongate snail with a small, narrow aperture. There is a single columellar tooth which continues on to become the anterior part of the peristome. The color is light brown, but often there is a spiral band of darker color on each whorl. There are about five whorls to a specimen 3 mm. long.

This species has been collected in beach drift at the east end of Deer Island.

## NUDIBRANCHIA
## DORIDIDAE

The branchial plumes are in an arc or circle, and can be retracted into a cavity. The rhinophores are also usually retractile. The dorsum completely covers the animal and over-hangs all the way around.

*Archidoris* ? sp. This is a green, oval nudibranch whose dorsum is covered with tubercles. The rhinophores have 14 lamellae, and are fully retractile into deeply notched tubercles. The branchiae number 13, some of which are branched. There are spicules in the dorsum. The underside is colored greenish yellow. The genital pore is located on the right side a short distance behind the head, and the mouth region is shaped almost like a boomerang with the convex side anterior. The radula is broad, and with about 84 simple hook-lie teeth in each row. There are two black eye spots on top of the cerebral ganglion.

The maximum size when fully expanded was about 40 mm. long by slightly over 20 mm. wide. They are oval in shape, but are a little broader at the anterior end.

A total of twenty specimens were collected by the writer at Dog Keys Pass in the trawl during March and April, 1960.

## AEOLIDIIDAE

Long slender nudibranchs with many cerata set in numerous close, transverse rows. They are broadest at the anterior end, and the foot usually tapers off to a point at the posterior. There are four simple tentacles, none of which can be retracted into holes, and the radula consists of a single broad plate.

*Aeolidia* sp.

Oral tentacles, white, very long and tapered; the anterolateral edge of the foot with a slender pointed projection. The rhinophores are small, smooth, and tipped with pale brownish orange. The tips of the cerata are colored pale orange, dark brown, and white. Length is about 40 mm.

One specimen was collected in Dog Keys Pass in April, 1960.

## PULMONATA
## ELLOBIIDAE

*Detracia floridana* Pfeiffer, 1856.

This is a small, almost football shaped species. There is a single strong columellar ridge at the anterior end of the columella, and there are eight or nine small teeth inside the outer lip. There is a single thin blade-like lamella on the columella. The color is light brown with darker spiral bands. The maximum size is about 8 mm., and there are about ten or eleven whorls.

This little snail is very similar in appearance to *Melampus bidentatus,* but differs in its nearly biconic shape, smaller size, and salinity range. When the two species are found together, it is always at the lower end of the salinity range for *M. bidentatus,* and *D. floridana* is never found in higher salinity areas where *M. bidentatus* is best established. Mississippi specimens were collected at Stark Bayou, Heron Bayou, and Davis Bayou in May, 1960, by Dr. Morrison and the author.

## PELECYPODA

## ANISOMYARIA

## ANOMIIDAE

The shell is thin and variable in shape, and, in the Atlantic genera, the calcified byssus passes through a hole in the attached valve. The ligament is more or less internal and is supplemented by an internal resilium. No hinge teeth.

*Anomia simplex* d'Orbigny, 1845.

The attached valve has an opening for the byssus, and there are three muscle scars in the top valve. The attached valve is flat, but the upper valve is quite convex. The shell is thin, and has no sculpture. The maximum size is about 50 mm.

## HETERODONTA

## CYRENOIDIDAE

The shell is thin, inflated, suborbicular, and with a brownish periostracum. Each valve has a pair of cardinal teeth, and there is a long external ligament which enfolds a smaller resilium.

*Cyrenoida floridana* Dall, 1896.

The shell is inflated, orbicular, and is covered with a yellowish brown periostracum. Maximum size is about 14 mm.

Two live juveniles and two dead shells were collected by Dr. Morrison in the estuary branches of Davis Bay. It has much the same salinity tolerance as *Detracia floridana,* and is confined to the fresh water side of the marshes. It is, like *Polymesoda caroliniana,* usually intertidal, but under cover of logs or other plant debris.

## LEPTONIDAE

*Lepton* ? sp.

The shell is thin, white, smooth and polished. It is equivalve, and is almost equilateral. The valves are oval in shape and the beaks are near the center of the dorsal margin. The maximum size is about 7 mm.

This little clam is commensal on the under surface of the abdomen of a large mantis shrimp, *Lysiosquilla scabricauda.* Like other members of the family, it is able to glide about on its foot like a gastropod, and was easily able to climb the glass sides of aquaria.

The generic designation here employed is very tentative.

## VENERIDAE

*Anomalocardia cunimeris* Conrad, 1846.

This clam is wedge shaped with a rounded anterior end, and with a sharp, pointed rostrum at the posterior end. There is a wide shallow escutcheon bordered by a weak ridge. The sculpture consists of rounded concentric ribs which are more prominent near the beaks. The color is variable. Maximum size is about 20 mm.

Four single valves were screened out of sand in a salt water pond on Horn Island by Dr. Morrison in May, 1960. They appeared to have been dead for some time.

## DONACIDAE

*Donax tumida* Philippi, 1849.

This is a small, obese species of surf clam. The beaks are swollen, and the posterior end is strongly truncate. There are beaded threads on the blunt posterior end, and a few incised, concentric lines on the anterior end. There are usually no rays of color, and the shell appears drab compared to the average *D. variabilis.*

This species lives out in deeper water than does *D. variabilis,* and a few specimens have been found by diving on the Gulf side of Ship Island.

## ADAPEDONTA

## MACTRIDAE

*Rangianella* sp. This is a small white species that is very similar to young *Mulinia lateralis.* There is an internal resilium, and each valve has a pair of lateral teeth of moderate length in addition to the cardinals. Maximum length is about 8 mm.

This species is common in Lake Pontchartrain, but was not found in Mississippi until May, 1960, when Dr. Morrison found it in Heron Bay. It is being described by Dr. Morrison.

Three of the species listed in this Supplementary Note have been reported by Parker (1956), but the remaining nine are new records for this region. The additional species increases the total for the area studied to 163.

## SUMMARY

The Mississippi coast consists of the irregular mainland shore. It is indented by several small bays, connecting with a long, narrow, shallow Sound. A series of barrier islands partly separates the Sound from the Gulf of Mexico on the south. The Sound is about 80 miles long by ten miles wide, and averages ten feet deep. About one-fifth of the eastern end lies in Alabama, but there is no important change in the environment throughout the area

The barrier islands apparently were built up some five or six thousand years ago after the sea level became stabilized at its present height. The Chandeleur group, to the south were formed at a much later date than the Mississippi islands, and Cat Island has since reoriented itself to face the open Gulf. As a consequence of barrier island formation, the Sound acts as a settling basin, and a thick deposit of mud now covers most of the bottom.

There is a gradually declining salinity gradient from the open Gulf to the rivers and bayous of the mainland. The salinity in the coastal waters and the Gulf remains rather stable, but there is considerable fluctuation near the mainland, especially in the bays and bayous after heavy and prolonged rains. Most of the streams flowing to the coast are small, but the Pascagoula, which flows directly into the Sound, and the Pearl, which empties into Lake Borgne about four miles west of the Sound, are medium sized rivers which originate some distance inland.

Other important physical factors are: temperature, which ranges from 4° C. in the winter to 30° C. in the summer; turbidity, which is almost always high; depth of water, from shallow depths mostly less than 20 feet to a maximum of 50 in the passes; currents, both tidal and wind driven, and the substratum. The bottom area of the Sound is made up of 5 per cent sand, 80 per cent clay-mud, and 15 per cent silt or sandy silt. The very small amount of hard bottom consists of oyster reefs, or man made structures around the shores.

Four classes of mollusks have been found on the Mississippi coast. The classes, and the number of species in each, are as follows: Gastropoda, 80; Scaphopoda, 2; Pelecypoda, 78; Cephalapoda, 3; total, 163. Previous published works have listed 51 of these, and 112 are new records for the area. Parker (1956) reported investigations to the east of the lower Mississippi Delta in which there was listed a large molluscan fauna taken from the tidal marshes to a depth of 40 fathoms. His list includes a great number of mollusks hitherto unreported from the north-eastern Gulf. Parker's work was done outside of the area treated here, but, even if his list is included, 68 of the species presently reported remain as new records for the north-eastern Gulf. A number of species listed by Johnson (1934) were said to live from Florida to Texas, or, more often, Gulf of Mexico. Since many of these records are for tropical or deep water species, they have caused considerable taxonomic confusion among biologists working in the coastal waters of the northern Gulf. More precise locality lists are needed.

By far the greatest number of species was found around the barrier islands on sand bottom in waters of fairly high salinity. Salinity is an important factor in connection with distribution of mollusks, but the type of bottom is also important, and a few euryhaline or partly euryhaline marine species, such as the snail, *Polinices duplicatus,* are found living around both the barrier islands and also on sandy areas along the mainland shore. The mud bottom of most of the Sound is rather barren, but a few species, for instance, *Callocardia texasiana,* appear to prefer this type of habitat. The molluscan fauna of low salinity waters consists of a small number of species typical of brackish water marshes and bayous.

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